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Letters to the Editor

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Summing up, we may say that Raman's paper of April 1922 not only established the reality of the phenomenon of the colour of the sea, which at the time was popularly regarded as being merely the reflection of skylight, but also placed its explanation on a firm foundation of accepted physical theory and demonstrable experimental fact. No publication that has since appeared on the subject has added anything really fundamental to the ideas set out in his paper, but only dealt with matters of detail relating to particular cases and particular circumstances. It might therefore be said that just as the theory of the colour of the sky is formally associated with the name of the late Lord Rayleigh, the explanation of the colour of the sea and of great masses of water generally should likewise be permanently associated with the name of Sir C. V. Raman. This was formally recognized by no less an authority than the late Sir William Henry Bragg who in his book *The Universe of Light* which is deservedly one of the most popular expositions of optics ever published devotes two pages to the explanation of the colour of the sea and gives the fullest credit to Sir C. V. Raman as having given the proper explanation of the phenomenon.

A. S. GANESAN.

NEW CARBON ISOTOPE, CARBON-16

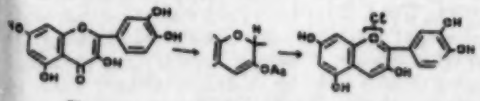
A NEW carbon isotope of mass 16 has been discovered by physicists of the Atomic Weapons Research Establishment, Aldermaston, working in collaboration with scientists of the Clarendon Laboratory, Oxford. A carbon-14 target was bombarded with a beam of 6 MeV. tritons (ions of tritium) from the Aldermaston Van de Graaff accelerator. In some cases, the force of the collision was observed to be sufficiently great to split the triton into its constituents of one proton and two neutrons and the neutrons were captured by the carbon-14 to form a new isotope, carbon-16. By making precise measurements with a large magnetic spectrograph on the emitted protons, the mass of the new isotope was found to be 16·014702 atomic mass units. It was anticipated that carbon-16 would suffer beta-decay like carbon-14 and carbon-15, but with the difference that the product of the decay would still have sufficient energy to emit a neutron. This occurred, and use was made of this property to measure the half-life, which was found to be 0·74 sec.—(*Nature*, 1961, 190, 586.)

PREPARATION OF FLAVYLIUM SALTS OF THE ANTHOCYANIDIN TYPE

H. G. KRISHNAMURTY AND T. R. SESHADRI
(From the Department of Chemistry, Delhi University, Delhi-6)

(A) Pelargonidin Group

FOR the past few years we have been interested in working out convenient methods for the preparation of anthocyanidin chlorides needed for biological investigations and also in studying the interconversion of flavonoids. Flavonols are easily available as natural products and they can also be readily prepared pure by laboratory synthesis. Their conversion into anthocyanidins has been investigated for a fairly long time. The earlier experiments of Willstätter,[1] Robinson[2] and others were not fully successful from the point of view of yield and purity of the products. More recently King and White[3] reported that they could obtain good yields of cyanidin (III) from quercetin (I) by the method of reductive acetylation using sodium acetate, acetic anhydride and zinc; similar conversion was effected using other flavonols. We had occasion to study this method closely and find it useful. The intermediate seems to be the corresponding flav-3-ene-3-ol acetate[4] (II) which undergoes conversion into the anthocyanidin on boiling with alcoholic hydrochloric acid. But the anthocyanidins were impure and showed absorption maxima lower by 15–20 mμ as compared with standard samples. The impurities responsible for this lowering can be removed by paper chromatographic purification.[5] But this is a tedious process and not suitable for preparative work. However, after the conversion into anthocyanidins if the acid solution is extracted once with ethyl acetate or several times with ether, the impurities are largely removed. This is then followed by further purification using transfer into iso-amyl alcohol and retransfer into aqueous 1% acid. The products then exhibit the correct absorption maxima. With this modification in the isolation of the anthocyanidins, the reductive acetylation method can be used as a general method for the preparation of 3-hydroxyflavylium chlorides.



I II III

Chart I

In the course of the study of the mechanism of the reductive acetylation we examined the behaviour of dihydroflavonols and obtained varying results in the nature of the resulting products in different experiments. As a cause of this discrepancy the possibility of initial dehydration of the dihydroflavonol and subsequent reductive acetylation of the flavone derivative was envisaged. To check this point taxifolin (IV) was boiled with acetic anhydride (i) without a base catalyst and (ii) with sodium acetate or pyridine. In the first case the product yielded only taxifolin penta-acetate. In the second case there was development of deep colour within 30 minutes of heating and at the end of the experiment, the product was found to be a new acetate; it was eventually discovered that under these conditions taxifolin undergoes an intramolecular rearrangement leading to the formation of cyanidin pseudo-acetate (V).[5] Subsequent deacetylation preferably with cold alkali (2%) led to the preparation of cyanidin (III). The experiments could be repeated with aromadendrin and dihydrorobinetin giving pelargonidin and robinetinidin respectively. This transformation is significant from the point of view of biogenesis of anthocyanidins because it shows that under suitable conditions a dihydroflavonol can directly give the corresponding anthocyanidin. The importance of dihydroflavonols as vital intermediates in the biogenetic evolution of flavonoids has already been emphasised.[6] The new result is a further addition to the possible transformations of dihydroflavonols.

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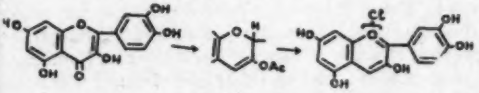

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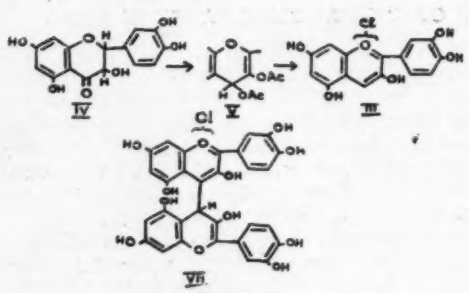

CHART II

(B) GESNERIDIN GROUP

Flavylium salts related to flavones, though not so numerous as those related to flavonols, seem to occur in fair number. Among them, gesneridin[9] was probably the only example (occurring as glycoside) known till 1934, but recently luteolinidin[10] and 5 : 7 : 3′ : 4′ : 5′-pentahydroxyflavylium chloride[11] have been added. This group of anthocyanidins exhibits great tendency to form anhydro colour bases and some of them are found only in this form.[12] Convenient methods for their preparation starting from flavones and flavanones are therefore useful. Flavanones undergo easy and quantitative reduction with sodium borohydride or lithium aluminium hydride to give flavan-4-ols; the use of the first reagent is simpler. These flavan-4-ols representing a simpler type of leucoanthocyanidins are converted into the corresponding flavylium chlorides when heated with hydrochloric acid in alcoholic solution. By the usual partition method of purification, the anthocyanidins can be obtained in an over-all yield of 10-15%. Slightly increased conversion could be effected by carrying out the transformation under anhydrous conditions. As representative examples apigeninidin (gesneridin X) and its O-trimethyl derivative have been prepared and their identity proved by comparison with standard samples synthesised by the method of Robinson. Unlike 3-hydroxyflavanones (dihydroflavonols), flavanones without the 3-hydroxyl do not undergo the base catalysed isomeric change mentioned above. No definite reasons for the failure can be given. It may be that appropriate conditions have yet to be found out.

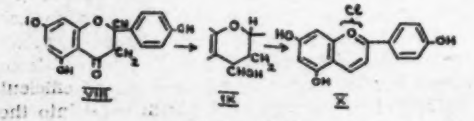

CHART III

The reductive acetylation method has now been extended to flavones and flavanones. It works well with a number of hydroxy- and methoxyflavones and gives good yields (40-50%) of chromatographically and spectrophotometrically pure flavylium chlorides; unlike the experiments with flavonols there is no difficulty of purification here. In a detailed study of apigenin (XI) and its methyl ether, the product of reductive acetylation seems to consist of a difficultly separable mixture of flav-3-ene (XII *a*) or flav-2-ene (XII *b*) and flavan-4-ol (IX) derivatives as could be judged from light absorption studies. The high yield of the anthocyanidin obtained is most probably due to the presence of a high percentage of flavene in the mixture.

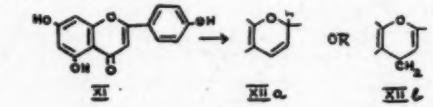

CHART IV

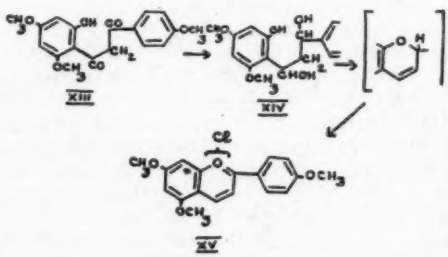

CHART V

As a simplification in steps, the use of 2-hydroxydibenzoylmethanes related to flavones has also been examined for the preparation of flavylium salts. These diketones are now easily available by the Baker-Venkataraman transformation of 2-aroyloxyacetophenones. 2-Hydroxy-4 : 6 : 4′-trimethoxydibenzoyl methane (XIII) underwent complete reduction with sodium borohydride to give the diol (XIV) which is sensitive to mineral acid and gives a deep pink colour in cold alcoholic acid solution. This colour, however, is not stable and changes to red. The diol slowly undergoes change into the corresponding anthocyanidin and some polymeric products. However, apigeninidin trimethyl ether (XV) can be obtained in an yield of about 40% by carrying out this conversion with a mixture of glacial acetic acid and concentrated hydrochloric acid or by saturating the benzene solution of the diol with hydrogen chloride gas. This reaction seems to be of general nature.

The flavylium ferric chloride was directly obtained by performing the above conversion in the presence of anhydrous ferric chloride.

Reductive acetylation of flavanones using as examples naringenin and its trimethyl ether has not so far yielded satisfactory results.

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THE BENGUELA CURRENT*

THE prime object of all marine research is the rational exploitation of available fish stocks and in the course of such investigations considerable essential knowledge on the fundamental aspects has also been accumulated. The reports based on the work done by R.R.S. *Discovery* and R.R.S. *William Scoresby* and published in the *"Discovery" Rep.* have considerably advanced our knowledge of the large water masses in the Southern Hemisphere in this regard. The present report based on the two surveys by R.R.S. *William Scoresby* deals with the water masses on the West Coast of South Africa about which not much is known.

The title might give one the impression that the account is mainly hydrographical and it may be stated at the outset that the authors have striven to make the report as complete as possible dealing with the biological aspects as well—phyto- and zoo-plankton, fishes, etc.

The report opens with an account of the earlier work in the region and environs, and describes the methods and itineraries of the survey. After dealing with the topography of the coastal region of South-West Africa and of the sea-floor, etc., the authors describe the prevailing winds, circulation of water, define what constitutes the Benguela Current, mechanism of upwelling and so on. The distribution of temperature, salinity, phosphate- and dissolved oxygen-content is shown and the effect of the last on fish life is pointed out. Decomposition of organic matter on the sea bed leads to further enrichment of the already phosphate-rich upwelled water.

The distribution of micro-plankton particularly the Diatomaceæ and its frequency of occurrence and dominance as well as the distribution elsewhere† of the typical Benguela Current species are given. The zoo-plankton of Survey I alone is dealt with; its interesting feature appears to be its greater independence of specific water masses than the phytoplankton and conspicuous patchiness in the distribution of some species. The phenomenon of discolored water caused by Diatomaceæ and Dinophyceæ and Ciliate elements are mentioned and their possible significance in relation to mortality of fish fauna discussed. The authors also deal with other forms of life in the current, fish, seals and whales and a reference is also made to the spawning grounds of the South African pilchard and to Guano Islands which are all of economic importance. A passing mention is made to the organic production of Benguela Current. It is found that many features of this Current are similar or analogous to other upwelling regions on the Western Coasts of North and South America and Africa,‡ regions which are known to be fertile as regards organic production.

Though like all expedition reports the one under review also suffers from lack of continuity of observations over a period of time (this is inevitable in a survey of such nature) the wealth of information contained therein is immense and valuable and the account, well presented and illustrated, will be welcomed by all interested in the study of the seas.

R. SUBRAHMANYAN.

* By T. John Hart and Ronald I. Currie, *"Discovery" Reports*, 1960, **31**, 123–298. Issued by the National Institute of Oceanography. (The University Press, Cambridge). Price 75 *sh.* net.

† Also Madras Coast, for instance, in the Indian region. Incidentally, it may be mentioned that a large number of Benguela Current species has also been recorded on the West Coast of India (R. Subrahmanyan, *J. Indian bot. Soc.*, 1958, **37**, 435–41).

‡ The West Coast of India may also be included in this category (*vide* R. Subrahmanyan, *Proc. Ind. Acad. Sci.*, 1959, **50**, 113–252).

USE OF IONISING RADIATIONS FOR FOOD PRESERVATION

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THE search for new and improved methods of extending the storage life of food is a never-ending task for chemists, physicists and food technologists. Ever since it became known that radiation in the form of X-rays could destroy or inhibit the growth of cell tissue, experimental work has been going on in the use of radiation to kill the spoilage organisms in certain foods.

These experiments have met with varying degrees of success and the present position is encouraging, but the end of the road has not yet been reached.

In general, the radiation used is obtained from one or two sources; high speed electrons produced by electrical machines such as the Cockroft-Walton generator or the linear accelerator, or "gamma rays" (which are similar to X-rays) produced by radioactive isotopes.

Use of radiation doses sufficiently large to sterilise meat (that is to kill all the normal spoilage bacteria) often results in unacceptable changes in colour, odour or taste, and so later experimental work has concentrated on giving a much lower "pasteurising" dose which serves to extend the storage life by a factor of three to five without the ill effects of the higher dosage.

Nutrient Values Compared

Chemical tests show that the nutrient value of irradiated food is no less than that of similar food which has been preserved by a heat treatment, and, in fact, volunteers in the U.S.A. have lived on a complete diet of such food for short periods. Animals have been fed on irradiated foods for more than one generation and no effect has been found on longevity or reproduction.

Owing to the high level of radiation at the processing point, strict control of the personnel employed is necessary and the radiation source must be properly screened to prevent the escape of dangerous radiation. It is expected, therefore, that when radiation processing becomes a commercial possibility, food will be taken to large packaging and radiation processing centres rather than being treated in small factory units. There is no danger of residual radioactivity in the food.

Waste radioactive material from nuclear power stations has been used for some food irradiation work, but economically there are serious disadvantages to the use of the material. Although regarded as waste material at the reactor, these fission products are extremely expensive to transport to the processing centre due to the heavy protective containers required. Another radioactive material, Cobalt 60, is also sometimes used for food irradiation. When these sources are used, the radiation given off continuously in all directions cannot be controlled except by removing the radioactive source from the vicinity of the processing line and placing it in a suitable "safe" place. Further, these sources produce radiation in the form of gamma rays which tends to pass through the product without being fully absorbed, and in order to receive the correct dose an extremely complicated handling system is required which passes the food on multilayer conveyor belts around the source.

Free electrons give the ideal method of irradiation provided that the beam used has sufficient energy to ensure effective dosage of the products from one, or both sides. The present form of food packaging in small units lends itself well to electron irradiation and the electrical machine, which can deliver a controlled, directional beam of electrons through the products, gives a much more efficient utilisation factor than the use of radioactive isotopes.

Direct and Indirect Accelerators

Electrical machines fall broadly into two classes —direct accelerators and indirect accelerators. The first type requires a very high electrical potential between an anode and cathode. Thus the energy level from machines of this sort is limited by insulation problems, and energies of three million electron volts in a simple machine represent the upper limit.

For the production of electrons above these energies indirect accelerators must be used. In this type of machine the necessary acceleration is obtained without the use of very high potentials. Where a large output of electrons at a high energy level is required the microwave linear accelerator is ideal. This machine uses radiofrequency waves to accelerate the electrons along a specially constructed waveguide.

Recent developments have produced reliable linear accelerators with a built-in safety system to protect both operator and machine in the event of incorrect operation. The machine can be mounted vertically over the conveyor belt for one-sided irradiation or horizontally with a device to split the electron beam for treatment on both sides of the product.

Further developments in valve technology have produced klystron valves which, when used to power a linear accelerator, will give many kilowatts of electron output at energies of 10 to 25 MeV.

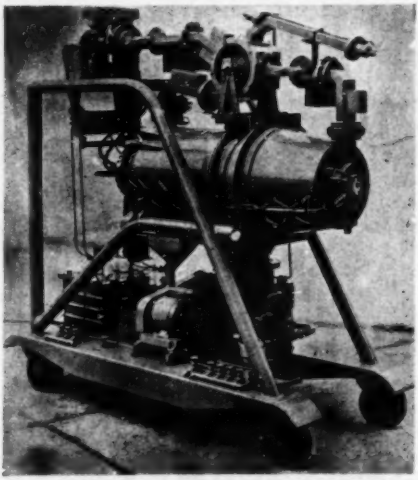

FIG. 1. The Mullard 4·3 MeV Travelling Wave Accelerator.

To assess the output and energy required to treat a given volume of product the following factors have to be assessed :—

1. *Thickness of Product.*—Electron penetration into unit density material is approximately half a centimetre per MeV so that to irradiate from one side a package 10 centimetres thick would require an electron energy in excess of 20 MeV. If the product were irradiated from both sides, an energy of only 12 MeV would be required.

2. *Utilisation Factor.*—This factor deals with the most efficient use of the electron beam. Electrons leave the machine in a narrow beam through a thin metal window, and in order to cover a conveyor belt, need to be scanned over the belt to achieve a uniform dose distribution in the product. A typical utilisation factor for flat packaged food products could be as high as 70% using double sided irradiation.

3. *Dose.*—This represents the amount of radiation necessary to achieve the desired result and is measured using a unit known as the "rad". This is defined as the dose corresponding to the absorption of 100 ergs per gram of irradiated material. In practice, doses used are measured in terms of millions of rads (the megarad) and as an example the pasteurisation of food requires a dose of about 0·1 to 0·5 megarads.

Combining these factors it is possible to calculate the amount of food which can be processed in a given time by any machine.

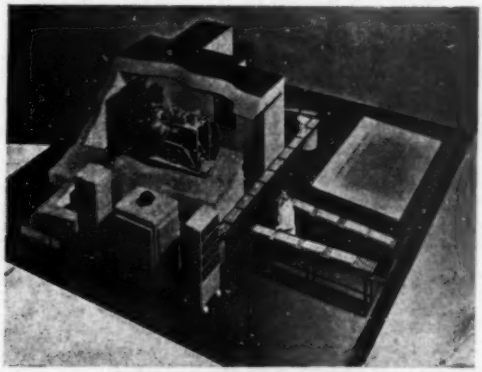

FIG. 2. The Mullard Accelerator being used to irradiate packaged foods.

Scientists working on food irradiation throughout Europe are now co-operating to combine the results of their work. Information is also fully available on the much wider programme in the United States so that the many problems still remaining should be solved more quickly.

First Applications of Process

Three specific uses of radiation in food processing have proved extremely successful and it is likely that these will be the first commercial applications of the process.

Root vegetables, such as potatoes, deteriorate in storage by the production of sprouts which take nutriment from the tubers and make them useless as food. A small dose of radiation will prevent potatoes from sprouting and the keeping time can be extended up to fifteen months.

Certain foods are liable to contain specific undesirable organisms such as trichinella spiralis in pork and salmonellæ in frozen or dried egg. Both of these organisms are responsible for serious food poisoning and it has been found that comparatively low doses of radiation can destroy them without damage to the product itself.

Grain is attacked by insects during storage and again it has been found that beetles and grain weevils are destroyed by small doses of radiation, but at present the problem of treating grain in very large quantities has not been solved.

The outlook for radiation processing of food is very promising but much work remains to be done. No irradiated food will be available to the public until an exhaustive series of tests

has proved that the food is safe for general consumption and its nutritive value has not been impaired. Legislation in the U.K. which already protects the public from the use of dangerous preservatives, assures that radiation, which is regarded legally as a preservative, will not be used until all the resources of analytical chemistry, biochemistry, pathology and histobiology have approved a long series of tests on such food. When these are satisfied, radiation processing may solve one of the most serious problems of mankind—that of assuring an adequate food supply at all seasons.—(*Courtesy*: *British Information Service.*)

NATIONAL PHYSICAL LABORATORY (ENGLAND), ANNUAL REPORT FOR 1960*

PIONEERING research in a number of important branches of physics is reported in the National Physical Laboratory's report for 1960. They include work on ultra-high pressures, physics of high polymers, autonomics, and noise measurements and control.

A combination of pressures up to 100,000 atmospheres and high temperatures can cause profound and permanent changes in the properties of certain substances. Using an ultra-high pressure apparatus built at NPL to a modified American design, the Basic Physics Division has carried out studies of the effect of pressure on the resistivity of semiconductors, and produced cœsite; a dense form of silica, and some very small artificial diamonds.

Polymers are widely used as plastics, synthetic rubbers and fibres and it is of great practical importance to discover the relationship between the structure of their long chain molecules and their electrical and mechanical properties. Work has continued during the year on measuring the dielectric properties and the low frequency dynamic properties of polymers.

Control of complicated industrial processes, such as the distillation column in an oil refinery, may be optimised by special computers permanently attached to plants and "learning" as the inputs and demands change. The first steps have been taken, with encouraging results, towards the building of an exceptionally fast analogue computer of such a kind. The high speed computer group is working on the development of the planar cryotron as a computing component. This gives promise of higher speeds, greater reliability, and smaller size for computers of the future. The division is also working on the mechanical translation of scientific Russian into English, automatic retrieval in libraries and automatic reading of both printed and hand-written numerals.

Subjective tests on motor vehicle noise are being made in the Applied Physics Division in collaboration with the Ministry of Transport, aimed at designing an instrument which will give a physical measurement of subjectively assessed noise for a wide range of vehicles. With the help of 1,300 Open Day visitors, an experiment on the unpleasantness of disagreeable noises was carried out last year to find out whether unpleasantness can be used as a criterion of judgment and if there is uniformity of judgment between different people.

Most of the work of the Aerodynamics Division consists of fundamental research in fluid dynamics needed by the aircraft industry. Hypersonic flow now forms a large part of this, and research has also continued on swept-back, slender and delta wings.

A crucial experiment in the Light Division was the attempt to measure light as a "visually weighted" radiation. This is radiation which has been passed through a filter transmitting, at every wavelength, a fraction proportional to the sensitivity of the eye at that wavelength. First results were very encouraging and aroused considerable interest. Further researches in this field may lead to an absolute radiometric method to the measurement of light. A small research group has been formed to study lasers, which are new powerful sources of nearly monochromatic light obtained by stimulating emission in fluorescent crystals. The aim will be to find out what factors control the light output and to build experimental lasers for pulse and continuous operation, which can be used in new applications. The new programme of the reorganized High Temperature Materials Laboratory will include a greater concentration on new materials of very high melting point.

Work in ferrous metallurgy by the Metallurgy Division, using the electron microscope, continues to make progress, and will have many industrial applications. During the year proposals for some new research programmes have arisen. They include a research development programme on high speed digital computers, a proposal for a research reactor, to be sited at Teddington, and one for a Van de Graaff electrostatic generator.

* *Report of the National Physical Laboratory for* 1960, published for D.S.I.R. by H.M.S.O., Price 9 *s.* 6 *d.*, by post 10 *s.* 2 *d.*

LETTERS TO THE EDITOR

ETCHING OF ANTIMONY SINGLE CRYSTALS

In continuation of our work on studies of etched surface of bismuth single crystals,[4] we report here our results on the etch phenomenon on single crystals of antimony. The experimental procedure was the same as described in our earlier work.[4]

The freshly cleaved specimen was chemically etched in a solution containing 3 parts $HNO_3 + 9$ parts tartaric acid $+ 1$ part water, for one to several seconds. In the initial stage of etching triangular etch pits distributed at random were observed. Moreover, there were two distinct types of pits, *viz.*, sharp triangles and rounded triangles. Rows of closely packed triangular etch pits with branching at some places (Fig. 1)

FIG. 1

were observed and with the increase in time of etching the pits became large and deep but the site of pits remained the same. The cleavage plane of the crystal was scratched quickly with a sharp needle and then subsequently etched in the above etchant. An array of triangular etch pits, lined up on many straight lines in a particular specified direction near the scratch, was observed. Dislocation etch pits have been observed on the cleavage plane of antimony produced by 3 parts HF, 5 parts HNO_3, 3 parts CH_3COOH and 1 part Br_2 (Lovell and Wernick)[1,2] and by 10 gm. $FeCl_3$, 30 ml. HCl and 120 ml. water (Shigeta and Hiramastu).[3] Among the different etchants tried by the authors the present etchant was found to be more suitable ; in this case with the increase in etching time the surface did not become tarnished and progressively dull as was the case with the other etchants used. One cleavage face was etched with one etchant and its counterpart was etched with another etchant and it was found that there was a close correspondence between the etch pits on both the faces. The etch pits obtained by the present etchant on cleavage (111) face of single crystal of antimony were similar to those obtained by earlier workers.[2,3] Considering their orientation and density of distribution it seems that the etch pits are formed at dislocation sites.

The authors are thankful to the Council of Scientific and Industrial Research, New Delhi, for financing the research scheme and for the award of a Junior Research Assistantship to one of them (V. P. B.).

Physics Department, N. S. PANDYA.
M.S. University of Baroda, V. P. BHATT.
Baroda, *June* 12, 1961.

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2. Wernick, J. H., Hobstetter, J. N., Lovell, L. C. and Dorsi, D., *Ibid*, 1958, **29**, 1013.
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4. Pandya, N. S. and Bhatt, V. P., *J. Sci. Industr. Res.*, 1960, **19 B**, 363.

FLUORIDE COMPLEXES OF URANIUM (IV) AND THORIUM WITH HYDRAZINE AND HYDROXYLAMINE

Hydrazine fluoride complex of uranium $UF_4N_2H_4HF$ has been isolated in this laboratory and will be reported.[1] The compound can be recommended as a suitable intermediate for the production of anhydrous uranium tetrafluoride. Though there is a close similarity between the physical behaviour of ammonia, hydrazine and hydroxylamine salts, so far no attempt has been made to prepare the corresponding hydroxylamine complex. The present note describes such an attempt for the preparation of the compound. When a mixture of uranylnitrate, hydroxyl amine, hydrofluoric acid is exposed to sunlight in presence of alcohol a green precipitate is obtained in about 10 to 15 minutes time and on further exposure more of the compound is formed. The compound on analysis has been found to possess the formula UF_4NH_2OHHF.

The compound on heating under vacuum at about 300° C. yields partially decomposed uranium tetrafluoride. The analogous hydrazine complex $UF_4N_2H_4HF$ on refluxing with formic acid gives uranium tetrafluoride. In this case, however, the hydrated tetrafluoride UF_4H_2O was obtained.

A more expeditious method of preparation, as compared to the photolytic one, of the above mentioned complexes has been achieved, by the use of copper ion as catalyst for the purpose of reduction. With 2 gm. of uranyl nitrate, 1 gm. of hydrazine hydrochloride or hydroxylamine hydrochloride, 20-30 c.c. of 40% hydrofluoric acid and 5 drops N/20 copper sulphate solution, the yield of the product is 95% in about 10 minutes time at 80-90° C. The fluoride complexes are obtained in the pure form as bright-green dense crystals.

Thorium is known to form isomorphous compounds with that of tetravalent uranium with which it is associated in certain minerals. Attempt was therefore made to isolate the analogous thorium fluoride complexes. When hydrofluoric acid is added to a solution of thorium nitrate in presence of hydrazine or hydroxylamine a flocculent white precipitate is immediately formed. On raising the temperature to 70-80° C. the precipitate settles down in fine crystalline form. The compounds on analysis have been found to be isomorphous with the corresponding uranium (IV) complexes and possess the formulæ $Th_4N_2H_4HF$ and ThF_4NH_2OHHF respectively.

Dept. of Chemistry, Ravenshaw College, Cuttack, *April* 5, 1961.

BALARAM SAHOO.
D. PATNAIK.

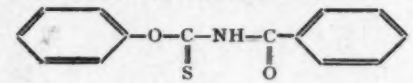
I. Balaram Sahoo, Tripathy, B. and Patnaik, D. To be published.

ACYL ISOTHIOCYANATES: FRIEDEL-CRAFT REACTION OF PHENOLS WITH BENZOYL ISOTHIOCYANATES

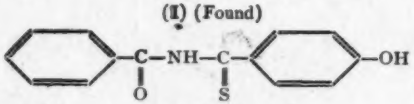
ISOTHIOCYANATES have been known to condense with phenols in presence of a Lewis acid. Thus Karrer and Weiss[1] studied the action of isothiocyanates and hydrogen chloride upon polyhydric phenols. They obtained in all cases substituted amides of the corresponding thioacids. For example, ethyl isothiocyanate with resorcinol afforded ethylamide of thioresorcylic acid. Rivier and Kunz[2] studied action of isothiocyanates on phenols in presence of anhydrous aluminium chloride. They reported that phenyl isothiocyanate when condensed with phenol gave thioanilide of *p*-Hydroxybenzoic acid *p*-$PhNHCSC_6H_4OH$ structure of which was also proved by these authors.

Acyl isothiocyanates have not apparently been studied. Benzoyl isothiocyanate was therefore selected for the present study, which was prepared according to Ambelang and Johnson.[3] This was then condensed with phenol according to details described in the experimental. The product contains nitrogen and sulphur and was proved to be N-benzoyl-phenyl-thiocarbamate (I) and not the expected N-benzoyl-thioamide of *p*-Hydroxybenzoic acid (II) since the hydrolysis of the final product gave only benzoic acid and no trace of *p*-Hydroxythiobenzamide or *p*-Hydroxybenzamide or *p*-Hydroxythiobenzoic acid.

Resorcinol is found to behave analogously. Condensation of other polyhydric phenols is under investigation and a detailed paper will be presented in future. It can be concluded from results that acyl isothiocyanates behave differently from alkyl isothiocyanates and undergo addition reaction with phenols in presence of a Lewis acid. This is probably because there is a strong additional electromeric shift due to keto group in acyl isothiocyanates.



(I) (Found)



(II) (Expected)

EXPERIMENTAL

Condensation.—Phenol (4 g.) was mixed with finely pulverised anhydrous aluminium chloride (8 g.) and benzoyl isothiocyanate (6·6 g.) was added dropwise with efficient cooling. The reaction becomes vigorous and the colour of the mixture changes to red. It was left overnight at room temperature and decomposed with ice-water next day. The semi-solid red mass solidified when chilled in ice-bath. It was crystallised from ethanol and finally with petroleum ether (80°) when pale-yellow, orange needles were obtained. It melted at 66° C. Yield 2·5 g.

$C_{14}H_{11}N.SO_2$ requires N, 5·83%; S, 12·45% (Found N, 5·61%; S, 12·40%).

The product was insoluble in alkali or dilute acid in cold. It did not give any colouration with alcoholic ferric chloride.

Hydrolysis.—Above product (1·0 g.) was refluxed with 10 ml. of 10% sodium hydroxide

solution on a water-bath for three hours and finally on a wire-gauze for fifteen minutes. The red solution obtained after filtration was cooled and acidified with conc. hydrochloric acid when smell of hydrogen sulphide was detected and confirmed by lead acetate paper. The pale-yellow solid after crystallisation from petrol-ether (using Norite for decolourisation) yielded colourless needles, m.p. 121°. Mixed melting point with authentic specimen of benzoic acid was undepressed.

Department of Chemistry, J. P. TRIVEDI.
St. Xavier's College,
Ahmedabad-9, *April* 27, 1961.

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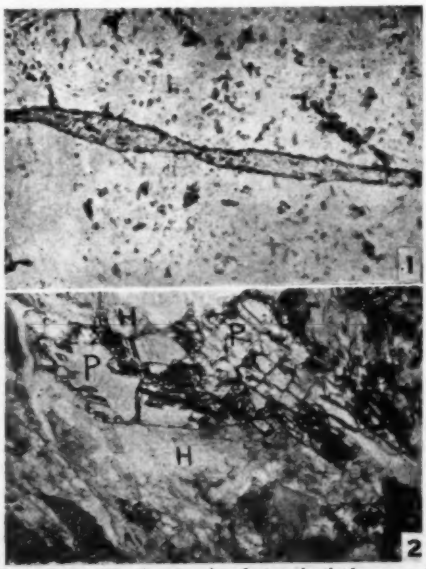
PISTACITE FROM THE GRANITES OF PUTALAPATTU, CHITTOOR DISTRICT, ANDHRA PRADESH

A STUDY of the granites of the Chittoor district undertaken by present author[1] has revealed the occurrence of pistacite in some of these rocks. The optical and chemical properties of pistacite occurring in the granites of Putalapattu (79° 6′ 19″ : 13° 20′ 38″) are set forth in the present paper.



FIGS. 1–2. Fig. 1. A vein of pistacite in leucogranite, × 46. Fig. 2. Pistacite in hornblende granite, × 50. P = Pistacite. H = Hornblende.

The granites of the area are mainly hornblende granites with local variations. The hornblende granite becomes leucogranite with the impoverishment or complete absence of hornblende, and granodiorite with increase in the hornblende. These granites have been traversed by numerous joints, of which the East-West set is the most prominent one. These granites are intruded by dolerite dykes which show the same trend as that of the prominent joints. The minor joints and cracks are localised with pistacite at certain places.

The occurrence of pistacite in these granites is mainly of two types. One occurs as a vein in leucogranite (Fig. 1) and the other is in association with the hornblende in the hornblende granite (Fig. 2). It is observed from the study of granites that the hornblende is getting reduced as the pistacite is increasing. The grain size of pistacite occurring in the form of vein varies from 0·02 mm. to 0·3 mm., while the width of the vein varies from 0·06 mm. to 1 cm. The pistacite which occurs in association with hornblende is coarser than the former and varies in size from 0·2 mm. to 0·5 mm. The leucogranite consists of quartz, feldspars (potash and plagioclase) and pistacite, while quartz, feldspars (potash and plagioclase), hornblende, pistacite, chlorite and iron ore constitute the hornblende granite. The proportion of the various minerals is known from the modal composition (expressed in volume percentage) of the two rock types, which are given in Table I.

TABLE I
Modal Compositions

Constituents	Leucogranite	Hornblende granite
Quartz ..	54·14	31·75
Feldspars ..	39·75	46·11
Hornblende ..	..	9·27
Pistacite ..	6·11	6·63
Iron ore and chlorite ..	..	6·24

The pistacite from the two rocks is separated by using bromoform. By this method pure crop of pistacite was obtained from leucogranite whereas the heavy crop from the hornblende granite contained hornblende and chlorite besides pistacite. The green-coloured pistacite is later hand-picked from the heavy crop so as to obtain the pure product. The separated pure minerals are analysed for the iron and manganese contents. These two constituents have been reckoned as Fe_2O_3 and Mn_2O_3. The optical properties of pistacites together with their Fe_2O_3 and Mn_2O_3 contents are given in Table II.

TABLE II

Optical and chemical properties of pistacite

Constants		Pistacite from leucogranite	Pistacite from hornblende granite
X	..	Yellow	Yellow
Y	..	Yellowish pink	Yellowish pink
Z	..	Bright yellow	Bright yellow
		X < Z < Y	X < Z < Y
(−)2V	..	72° to 76°	68° to 79°
γ−α	..	0·041	0·037 to 0·045
X ∧ c	..	4°	4°
Fe_2O_3	..	11·23	8·14
Mn_2O_3	..	0·29	0·35

Table II reveals that there is a general agreement between the two minerals in their optical characters. Regarding their chemical characters, Fe_2O_3 is significantly higher than Mn_2O_3 in both the minerals, the mineral from leucogranite is richer in Fe_2O_3 than the other. The optical constants, 2V, γ−α and X ∧ c of the minerals when they are plotted in the Winchell's variation diagram[2] for epidotes show that the minerals are richer in $HCa_2Fe_3Si_3O_{13}$ molecules than $HCa_2Al_3Si_3O_{13}$ molecules, falling in the range of pistacites. The richness in Fe_2O_3 and the extreme paucity of Mn_2O_3 in these two minerals also confirm that they are pistacites.

It may be suggested that the pistacites are formed due to the hydrothermal alteration of plagioclase in the vein and the hornblende in the hornblende granite. This suggestion is evidenced by the vein development through minute cracks. According to Bateman[3] the widening and thinning of the vein and non-matching walls in the vein (Fig. 1) are some of the criteria for the hydrothermal replacement.

Similar occurrences of epidote group of minerals were noticed by the author near Puttur (79° 34′ : 13° 25′ 6″) and by Chakrapani Naidu and the author near Bhakrapet (79° 10′ 30″ : 13° 41′ 4″). A detailed investigation on the occurrence of the epidotes in the granites of Chittoor district and their significance to the genesis of the granites is in progress.

The author expresses his deep sense of gratitude to Prof. M. G. Chakrapani Naidu, for his helpful suggestions and encouragement.

Dept. of Geology, M. S. MURTY.
S.V. University College,
Tirupati, *April* 5, 1961.

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A NEW PEPTIDE FROM BRAIN

DURING the course of our investigations on the Amino-acid pattern in the various areas of monkey-brain, we have observed a peptide band present in all the areas of brain. The peptide is characterised by its high R_f value, in the solvent system of Partridge[1] (Butanol : Acetic acid : Water 4 : 1 : 5, top layer), occupying the position farther than the farthest amino-acids, leucines, on the chromatograms. The unique position on the chromatograms and the subsequent amino-acid analyses have shown that it is different from the three peptides reported by Boulanger and Biserte[2] from brain tissues.

The peptide has been isolated as follows: Whole brain of monkey was homogenized in cold trichloroacetic acid, the protein-free extract extracted thrice with ether to remove acid. The extract is concentrated under reduced pressure. The concentrated extract is chromatographed on a cellulose powder column, elution being carried out by the same solvent system of Partridge. Since this peptide is the one having the highest R_f value in this solvent system, it comes out of the column in the first fractions itself. Fractions, 5 c.c. each, are collected, serially numbered and concentrated at room temperature, under a current of air. The individual fractions are again paper-chromatographed, and those which contain only the peptide (single peptide band) are pooled and analysed for its amino-acid content.

The sample is hydrolysed with 6N HCL at 110° C. in a sealed tube for 18 hours, and the acid removed by repeated evaporations on a water-bath. The presence of tryptophan is tested on the unhydrolysed peptide sample, by means of the glyoxylic acid test, which is negative. Cystine and methionine were found to be absent in the hydrolysed peptide, by means of the platinic-iodide test. Pauly's reaction for imidazoles, on the chromatographed peptide hydrolysate, showed the presence of tyrosine, and the absence of histidine. The Sakaguchi reaction for arginine is positive. Proline and phenylalanine were confirmed by isatin spray.[3] By a combination of the specific colour reactions and chromatography in different solvent systems,[3-5] the following thirteen amino-acids have been found to be present in the hydrolysate of the peptide: α-Alanine, γ-Aminobutyric acid, Arginine, Aspartic acid, Glutamic acid, Glycine, Isoleucine, Lysine, Phenylalanine, Proline, Serine, Threonine and Tyrosine. Quantitative amino-acid analysis of the peptide hydrolysate, by the method of Giri *et al.*,[4] using the two

solvent systems,[3] gave the following molecular proportions of the amino-acids :
Isoleucine-6, Aspartic acid-5, Glutamic acid-5, Phenyl alanine-3, γ-Aminobutyric acid-3 α-Alanine-2, Glycine-2, Serine-1, Threonine-1, Lysine-1, Arginine-1, Proline-1 and Tyrosine-1.

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DISTRIBUTION OF UREASE WITHIN THE SEEDS OF *CAJANUS INDICUS* AND THE EFFECT OF MATURITY ON UREASE CONCENTRATION

NATH AND MUKHERJEE[1] stated that urease prepared from the seeds of *Cajanus indicus* was satisfactory for blood urea determination and that colour and turbidity changes after nesslerization were more delayed than after use of commercial urease preparation. It appeared of interest therefore to study the concentration of urease at different stages of maturity and in different parts of the seeds of *Cajanus indicus*. Seeds obtained from plants growing on similar soil in a small plot were used. Both the red and black varieties were taken for the study of the effect of maturity. Seeds of each variety were roughly classified into immature, mature and dry seeds and used simultaneously for urease determination. Only the mature seeds of the red variety were used for studying the distribution of urease. While dissecting individual seeds, the testa, the micropyle, the germ and the cotyledon were kept in petri dishes covered with moist filter-paper to prevent evaporation, and used without delay. Urease activity was determined by the method described by Damodaran and Sivaramakrishnan[2] on freshly prepared homogenates of approximately 1% concentration (on dry weight basis). The results obtained are given in Tables I and II.

TABLE I
Effect of maturity on urease content of seeds of Cajanus indicus

Variety	Maturity	Moisture %	Dry weight per 100 seeds (g.)	Mg. urea hydrolysed/hr./g. of dry* material	Mg.* urea hydrolysed/seed/hr.	Urease activity/seed %
Red ..	Immature	79·4	1·08	207	2·2	3·2
	Mature	63·0	4·93	805	39·7	58·3
	Dry	7·7	6·79	1003	68·1	100·0
Black ..	Immature	71·0	2·58	476	12·3	27·8
	Mature	61·7	5·39	577	31·1	67·5
	Dry	9·3	5·54	832	46·1	100·0

* Fresh seeds were used for determination of urease activity.

TABLE II
Distribution of urease in the different parts of the mature seeds of the red variety of Cajanus indicus

Part of seed	Moisture %	Mg. urea hydrolysed/hr./g. of dry material	Part present in 100 g. dry* seeds	Urease % of total activity in seed
Micropyle	54·9	49	2·77	0·1
Testa ..	63·9	69	12·69	0·8
Cotyledon	51·4	1311	82·92	96·8
Germ ..	35·7	1624	1·62	2·3

* Fresh seeds were used for determination of urease activity.

It would appear from results presented in Table I that the concentration of urease in the seeds was low in the immature seeds and maximum in the dry seeds. That this difference was less marked for the black variety can be explained on the basis of the relatively higher maturity of the immature black seeds. As a source for the preparation of the urease concentration, the dry seeds are therefore more suitable. The dry seeds of the red variety had a slightly greater concentration of the urease than those of the black variety.

From the results presented in Table II, it is clear that though urease activity on a unit weight basis is highest in the germ, the maximum concentration (96·8%) of the enzyme was in the cotyledon. The amount of urease in the micropyle, testa and germ together constituted only 3·2% of the total enzyme in the seed.

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PRESERVATION OF ALCOHOLIC SOLUTION OF FURFURAL AS A READY REAGENT FOR BAUDOUIN TEST

In performing the Baudouin test there is a necessity to use freshly distilled furfural. This limitation has often been levelled against the test as a criticism. Among the many methods suggested to prevent furfural from deterioration (which is due to auto-oxidation), one is the storage in an oxygen-free atmosphere.[1] The modification previously reported from this laboratory[2] is the storage of required amounts of 2% alcoholic solution of furfural for each test in small amber-coloured ampules. Thus preserved, we had observed that the alcoholic solution of furfural kept well indefinitely. This gave us the idea of studying the effect of storage in bulk a 2% alcoholic solution of furfural in stoppered amber-coloured bottles. Results of observations of the so preserved solution are recorded here.

Table I

Storage trials of 2% alcoholic solution of freshly distilled furfural at different temperatures for Baudouin test in amber-coloured glass-stoppered bottles

Sl. No.	Storage temperature	Lovibond Units (Red) in 1 cm. cell				
		0	1	2	3	4 weeks
I.	0-5° C. (Ice chest)	9·0	9·0	9·0	8·0	7·5
II.	25–28° C. (Room Temp.)	9·0	9·0	8·0	8·0	7·5
III.	37° C.	9·0	9·0	9·0	8·0	7·5
IV.	42° C.	9·0	9·0	8·0	7·5	7·0

The observations have been made by storing the alcoholic solution at different temperatures for 4 weeks. Since the solution has stood well as judged by its use for the Baudouin test for 4 weeks at 42° (Table I), it is considered that this is sufficient improvement as a method to be adopted, since it would save labour and time for the analyst from his having to distil furfural each day a test is to be performed.

The author's thanks are due to Dr. M. Srinivasan for many helpful suggestions and to Dr. V. Subrahmanyan, Director, for his kind interest.

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LEAF PROTEINS IN NUTRITION

The possibility of using proteins isolated from various types of leaves as dietary supplements to improve the quality and raise the protein level of deficient diets was suggested by Pirie.[1,2] The value of certain leaf proteins as supplements particularly in respect of their high lysine and valine contents has been well recognised by protein nutritionists. Systematic work on the isolation of leaf proteins both in laboratory and pilot plant scales from varied sources has been carried out by Pirie,[3] Slade *et al.*[4] and Guha *et al.*[5] Sur and Subrahmanyan[6,7] reported the supplementary value of lucerne leaf flour to the poor rice diets.

From the amino-acid composition of leaf proteins reported in literature[8] it was seen that lysine contents of most of these proteins compared favourably with those of animal proteins. However, the methionine contents of the leaf proteins analysed have not been found to be high enough to prove of any supplementary value to the cereal and pulse proteins. But there had been stray cases of leaf proteins such as those from Spinach (*Spinacia oleracea*) whose methionine contents were found to be similar to those occurring in milk or egg. The object of the present investigation was to carry out a survey on the methionine contents of a number of leaf proteins including those which have not so far been analysed for this sulphur amino-acid.

Crude proteins were isolated by the simple method of extraction described by Pirie[3] from the following leaves: Drumstick (*Moringa oleifera*), Methi (*Trigonella fœnumgrœcum*), Lettuce (*Brassica oleracea capitata*), Grass (*Hordeum vulgare*), Bengal gram (*Cicer arietinum*), Bamboo (*Bambusa arundinacea*), and Spinach (*Spinecia oleracea*). In all cases only fresh leaves were used. Moisture, protein, fibre and ash were determined by standard methods. Methionine was estimated using McCarthy and Sullivan's colorimetric method.[9] The results are given in Table I.

The protein content of the crude extraction products varied widely depending upon the source. The highest value for protein obtained was for Methi while Bamboo contained the lowest amount of proteins. Except in the case of Methi the methionine content was more or less uniform in the proteins analysed. It is of interest to note that the values for this sulphur amino-acid obtained for Spinach, Bengal gram, Bamboo and a species of grass compared favourably with those reported in literature[10] for whole egg (3·3%), milk (2·4%) and meat

TABLE I

Composition of certain crude leaf proteins

Protein source	% Moisture	% Protein (N×6·25)	% Fibre	% Ash	Methionine (g. per 16 g. N)
Spinach (*Spinacia oleracea*)	4·3	47·9	1·7	2·3	2·7
Drumstick (*Moringa oleifera*)	5·3	49·2	1·9	1·6	2·2
Lettuce (*Brassica oleracea*)	4·2	57·2	2·9	3·1	2·3
Grass (*Hordeum vulgare*)	7·1	37·4	8·5	1·3	2·7
Methi (*Trigonella fœnum-graecum*)	6·3	61·2	3·6	6·3	1·0
Bengal gram (*Cicer arietinum*)	4·7	60·6	1·9	5·3	2·6
Bamboo (*Bambusa arundinacea*)	8·1	19·3	1·0	4·3	2·5

(2·1%). This would indicate the added value of the leaf proteins tried in our experiments as supplements to the cereal and pulse proteins in Indian diets which are generally poor both in lysine and methionine.

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OVINE ABORTION DUE TO *TOXOPLASMA GONDII* IN INDIA

DURING the course of routine histopathological examination of tissues, spherical and aseptate pseudocyst-like structures resembling those of *Toxoplasma gondii* measuring about 45 microns in diameter were encountered in Giemsa-stained uterine section of an imported Australian Polwarth ewe that aborted and died at the Central Wool Research Station, Rishikesh, in Uttar Pradesh, India. The cysts gave rise to no inflammatory reaction in the surrounding tissues apparently due to a resistant cyst wall that prevented escape of antigenic and chemotactic substances.[1] The individual parasites within the pseudocyst were crescent or arc-shaped, with one end attenuated and the other more rounded measuring about 2 to 4 microns in width and 4 to 7 microns in length. The absence of nuclei and radial striations in the cyst-wall and lack of evidence of compartments differentiated the cysts from those of *Sarcocystis*[2] while their smaller size (45 to 50 microns) and absence of lobulation and septation distinguished them from those of *Besnoitia* and the 'M' organism.[2] Unfortunately, no parasitological and serological study could be carried out to clinch the issue.

During the last 6 to 7 years, more than 2,500 serum samples from ewes that aborted were tested for evidence of agglutinins against *Brucella* with entirely negative results while ætiological studies failed to reveal any microbial factor other than a single isolation of *Listeria monocytogenes*[3] in majority of the specimens examined so far.

Since the cause of abortion in at least 85 to 90% of cases remained undiagnosed, we undertook the present investigation to ascertain the possible role of *Toxoplasma gondii* which had already been found to possess abortifacient potential causing sporadic and enzootic illness in sheep elsewhere.[4-7]

As many as 50 sera samples taken from imported Polwarth ewes that recently experienced abortion at the Central Wool Research Station, Pashulok (Rishikesh), were examined by Sapin-Feldman dye test,[8] complement-fixation,[9] indirect hæmagglutination,[10] its antiglobulin[11] modification and gel-diffusion[12] procedures. All sera were inactivated at 60° C. for 20 minutes before testing. The results of serum antibody tests showed that as many as 40 (*i.e.*, 80%) reacted at titres of 1 : 128 to 1 : 1,024 in the cytoplasm-modifying antibody technique. The values in the procedures were comparable in that all the above samples

exhibited a reaction zone higher than 1 : 32 in the latter four techniques. No other microbial pathogen was isolated on bacteriological examination of only ten samples that were cultured so far. It is interesting to report that about 20 to 30% of ewes that lambed normally also showed higher titres, indicating the important fact that maternal toxoplasmosis did not always kill fœtus. A follow-up study of the healthy lambs of these ewes which had high antibody levels is being carried out and attempts are afoot to isolate *Toxoplasma gondii* by inoculation of brain and liver emulsion of fœtuses into mice on the spot at the farm.

This is the first report in this country on the occurrence of the uterine form of toxoplasmosis in imported sheep from Australia where cases of toxoplasmosis had been described earlier, raising the important issue of the possibility of introduction of exotic diseases through importation of carrier animals. However, it is possible that toxoplasmosis may be prevalent in indigenous sheep in this country and only the results of further investigations on the subject can settle this issue.

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MORPHOLOGY OF ONGE FOOT

THE Onge are a small isolated community living in Little Andaman (10° 40′ North Lat. and 92° 30′ East Long.) which is the southernmost island of the Andaman Archipelago situated in the Bay of Bengal. They are gradually diminishing in number, possibly as a result of prolonged inbreeding, and at present their total strength does not exceed 200 individuals. They live in dense tropical forest and walk barefooted many miles a day for hunting and collecting food. Physically they belong to the Negrito race who are more commonly known as Asiatic Pygmies.

This note is based on the material obtained from ten adult male Onges who came to Port Blair by canoes in September 1960. All of them were healthy and free from any deformity of foot. Contour tracings of their feet were carefully made according to the method described by Sarkar (1958). The morphological characters studied are the length (acropodion to pternion) and breadth (metatarsale tibiale to metatarsale fibulare) of foot, the length-breadth index of foot, hallux divergence angle and the relative lengths of hallux and second toe. The sample-size is admittedly too small to draw any valid conclusion.

The data are given in Table I along with the measurements of certain other aboriginal groups. It is apparent that in comparison with other tribes the absolute length of Onge foot is smallest and its absolute breadth exceeds only that of Vedda and Pahira feet. The values of length-breadth index shows that the Khasi have relatively broadest feet, the Onge occupy second position in this regard. The value of hallux divergence angle is maximum among the Onge which indicates that the deflection of hallux in Onge foot from the second toe as well as from the central axis of foot is greatest. In seven Onges the hallux was seen to be greater than the second toe in both feet (Minami's TT type), in three individuals the second toe was greater (Minami's FF type). No heterotype was found.

Schebesta (1952) has given the foot measurements of some Negritos of Malay Peninsula and Philippine Islands. His average figures for the Semang are : length 23·1 cm., breadth 10·2 cm., index 44·1, and for the Aeta : length 22·7 cm., breadth 10·0 cm., index 44·0. The Semang and Aeta feet thus appear to be broadest, broader even than that of Khasi, though they do not differ much from Onge foot in average length and breadth. It must, however, be mentioned here that Schebesta's measurements were obtained by direct method which yields results

TABLE I

Sr. No.	Tribe	No. of feet	Foot length (cm.) Range	Foot length (cm.) Mean	Foot breadth (cm.) Range	Foot breadth (cm.) Mean	Length Br. index Range	Length Br. index Mean	Hallux divergence angle Range	Hallux divergence angle Mean	Author
1	Onge ..	20	21·7–23·6	22·6	8·4–10·1	9·4	36·7–44·5	41·3	7°–11°	8·9°	Present study
2	Juang ..	86	21·2–26·8	24·2	8·6–11·8	9·6	36·1–45·1	39·7	4°–10°	5·9°	Sarkar
3	Oraon ..	88	22·5–28·0	26·0	8·4–11·7	10·1	36·0–44·2	39·8	4·5°–9°	6·7°	do.
4	Pahira ..	58	19·1–25·7	23·0	7·5–10·9	9·3	36·9–44·2	40·4	5·5°–10·5°	6·0°	do.
5	Mundari ..	90	22·7–27·4	25·1	8·8–11·5	10·0	32·4–44·0	40·0	4·5°–9·5°	6·3°	do.
6	Vedda ..	26	17·3–24·9	23·0	7·1–10·3	8·5	31·4–41·4	36·5	..	..	Osman Hill
7	Khasi ..	112	21·2–26·4	23·6	8·4–11·4	10·1	37·0–47·8	42·4	4·5°–9·5°	7·0°	Das and Uzir
8	Rabha ..	600	20·0–27·8	24·0	8·0–11·3	9·8	34·3–47·5	40·7	4·5°–10·0°	6·7°	do.

slightly different from that obtained by contour method.

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SKELETO-MUSCULAR SYSTEM OF THE SUCKING PUMP OF *PAPILIO DEMOLIUS* L. (LEPIDOPTERA : PAPILIONIDAE)

IN course of his studies on the sucking pump of lepidopterous insects, the present writer came across two papers on the morphology of the head of *Papilio demolius* L. (Vasudeva, 1956; Srivastava, 1957). The two accounts were, however, found to differ considerably from each other in details. It was, therefore, considered desirable to attempt the problem again in order to arrive at a definite conclusion. Such a study proved very fruitful and resulted in the discovery of some interesting features. The present note deals with the extrinsic muscles of the sucking pump.

The cranial muscles of the sucking pump can conveniently be divided into three groups, *viz.*, stomœdæal muscles, cibarial muscles, and labral muscles.

Stomœdæal Muscles.—These muscles consist of two pairs. Vasudeva (1956) shows a single "dilator of pharynx", originating on the "frons" and the "epistomal ridge" and inserting on the dorsal and posterior walls of the pump. Srivastava (1957) calls it "frontopharyngeal muscle" which, according to him, arises from the "inflected part of the frons".

First Stomœdæal Dilator (Fig. 1; 1).—This muscle arises on the inflected part of the frons (Fig. 1; IF) (which forms the uppermost part

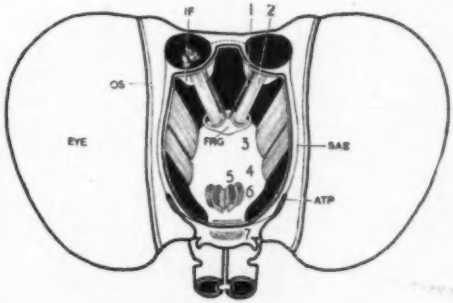

FIG. 1

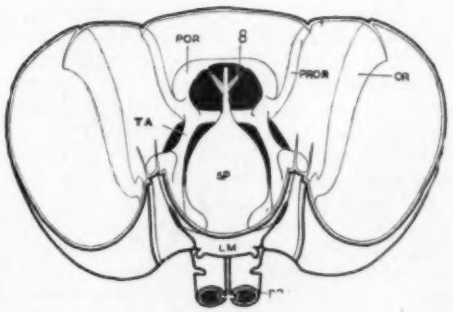

FIG. 2

FIGS. 1-2. Fig. 1. Anterior view of head with greater part of frontoclypeus cut away to expose the pump. *OS*, Ocular sulcus; *SAS*, Sub-antennal sulcus; *ATP*, Anterior tentorial pit; *FRG*, Frontal ganglion; 1, 2, 3, 4, 5, 6, 7, muscles described in text. Fig. 2. Inside view of head with greater part of the antero-dorsal area cut away obliquely. *POR*, Post-occipital ridge; *PROR*, Par-occipital ridge; *OR*, Ocular ridge; *TA*, Tentorial arm; *SP*, Sucking pump; *LM*, Labrum; *PR*, Proboscis; 8, Muscle described in text.

of the composite frontoclypeus), and is inserted on the dorsal wall of the pump behind the frontal ganglion (Fig. 1; FRG).

Second Stomœdœal Dilator (Fig. 1; 2).—This muscle is stouter than the first dilator. It arises lateral to the first dilator and is inserted likewise on the dorsal wall of the pump behind the frontal ganglion.

Cibarial Muscles.—These are divisible into two distinct groups, *viz.*, a postero-lateral group and an antero-median group. Each of these groups consists of two pairs of muscles.

Vasudeva (1956) shows two contiguous pairs of muscles (Clypeal dilators in her text and Fig. 11; but "frontal dilators" in her Fig. 10), composing the postero-lateral group. Srivastava (1957), however, describes a single pair of "subantenno-buccal muscle" arising on the "oculo-antennal ridge".

The antero-median group, according to Vasudeva (1956), consists of a median mass of fibres which she labels as "dilator of buccal region". Srivastava (1956), however, describes a single pair of "posterior clypeocibarial muscle".

First Postero-Lateral Dilator of Cibarium (Fig. 1; 3).—This is the largest muscle of the pump. It arises partly from the dorsolateral part of the frontoclypeus (obviously belonging to clypeus) and partly from the ridge of the sub-antennal sulcus, and is inserted on the dorsal wall of the pump, anterior to the frontal ganglion.

Second Postero-Lateral Dilator of Cibarium (Fig. 1; 4).—This is a little less stout than the first postero-lateral dilator. It arises anterior to (3) and is likewise inserted on the pump.

First-Antero-Median Dilator of Cibarium (Fig. 1; 5).—This short muscle arises on the antero-median part of the frontoclypeus (obviously belonging to clypeus) and is inserted on the dorsal wall of the pump, anterior to the frontal ganglion.

Second Antero-Median Dilator of Cibarium (Fig. 1; 6).—This short muscle is slightly larger than the first antero-median dilator. It arises lateral to the first dilator and is likewise inserted on the dorsal wall of the pump.

Labral Muscles.—The labral muscles are composed of a single bundle of fibres. Vasudeva (1956) and Srivastava (1957) describe this bundle as "clypeal dilator of mouth", and "anterior clypeal cibarial muscle" respectively. This labelling seems to be based on interpreting as clypeus an area which actually belongs to the labrum.

Labral Compressor (Fig. 1; 7).—This unpaired median muscle arises on the dorsal wall of the labrum and is inserted on its ventral wall, near the latter's junction with the dorsal wall of the pump. Eastham and Eassa (1955) in *Pieris brassicæ* L. also label this muscle as labral compressor.

In addition to the muscles described above, the present writer has observed a paired muscle which arises on the dorso-lateral part of the post-occipital ridge (Fig. 2; POR), and is inserted on the posterior part of the stomœdæum just before the latter leaves the head. Both Vasudeva (1956) and Srivastava (1957) make no mention of this muscle in their respective papers. This is the first time such a muscle is being described in a lepidopterous insect. Alam (1951) in *Stenobracon deesæ* Cam. (Hymenoptera: Braconidæ), describes a pair of more or less similarly oriented muscles (Occipital dilators of posterior pharynx). The present writer proposes to label the new muscle in *Papilio demolius* L. as the *Post-occipital dilator of stomœdœum* (Fig. 2; 8).

The author wishes to acknowledge his gratitude to his teacher Dr. S. M. Alam, and to Prof. M. B. Mirza, for providing all facilities.

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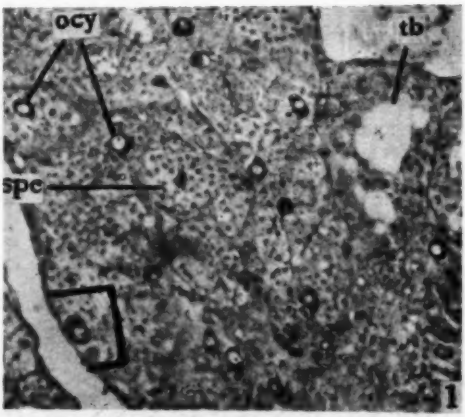
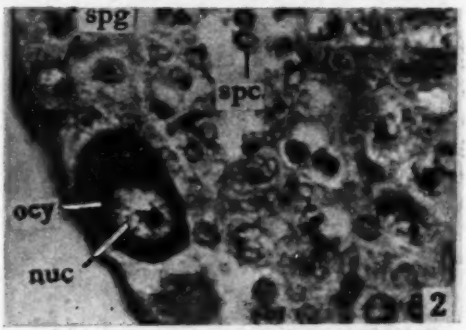
AN INSTANCE OF HERMAPHRODITISM IN THE CATFISH *MYSTUS VITTATUS* (BLOCH)

OCCASIONAL hermaphroditism is recorded in several species of teleosts such as *Hilsa ilisha*,[1] *Huro salmoides*,[2] *Cirrhina reba*,[4] *Rastrelliger canagurta*,[3] and *Barbus stigma*.[5] It is evident from the available literature that the testicular and ovarian components of the hermaphrodite gonad vary greatly in their disposition and relation with each other.

The male specimen of *Mystus vittatus* reported here was collected from the river Ganges at Varanasi during March 1961. This species

exhibits sex dimorphism and the males can be easily identified by the presence of a distinct urinogenital papilla. The ovo-testis resembles a typical normal testis for external appearance. It is a paired narrow elongated structure, the outer margin of which is thrown into finger-like processes with attenuated tips. The testis was in the early prespawning phase, showing actively dividing germ cells. All stages of spermatogenesis could be made out, and some of the testicular tubules contained a number of spermatozoa also. Among the testicular substance Stage I oocytes are found scattered without any regular order (Fig. 1) and few are even intratubular. These oocytes readily take up Hæmatoxylin stain. The oocyte nucleus shows a prominent nucleolus (Fig. 2). The larger oocytes among them measure 27 μ in diameter.





FIGS. 1–2. Fig. 1. Distribution of oocyte in the testis, × 180. Fig. 2. A single oocyte enlarged—inset in Fig. 1, × 780.

Technique—Bouin's fluid, Harris hæmatoxylin and Eosin.

Nuc, Nucleus. *Ocy*, oocyte. *Spg*, spermatogonium. *Spc*, spermatocyte. *tb*, testicular tubule.

The authors are indebted to Dr. Ray-Chaudhuri, Professor of Zoology, Banaras Hindu University, for providing all facilities and encouragement.

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METACERCARIA OF *EUMEGACETES* Sp. (TREMATODA : LECITHODENDRIIDAE) IN DRAGON-FLY NAIADS FROM A STREAM AT WALTAIR

IN the course of investigations on larval stages of trematodes from various freshwater organisms, dragon-fly naiads (Family : Libellulidæ), from a slow-running stream at Waltair, were frequently found infected with encysted metacercariæ. The cysts were mostly found in the hæmocœl in the posterior region of the body. The cyst wall is tough and thick. The size of the larva varies according to the stage of development. A well developed metacercaria (Fig. 1) as judged from the condition of the

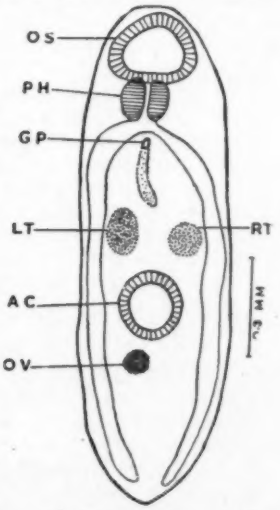

FIG. 1. Metacercaria of *Eumegacetes* sp.
AC, Acetabulum; *GP*, Genital pore; *LT*, Left testis; *OS*, Oral sucker; *OV*, Ovary; *PH*, Pharynx *RT*, Right testis.

reproductive organs measures 1·55 mm. in length and 0·5 mm. in breadth. The body cuticle is smooth and without spines. The subterminal oral sucker (OS) measures 0·23 mm. × 0·26 mm., being slightly larger than the acetabulum (AC) measuring 0·21 mm. in diameter and situated at a distance of 0·95 mm. from the anterior end. The conspicuous pharynx (PH) is 0·11 mm. × 0·16 mm. and directly leads into the intestinal cæca reaching the posterior end. Reproductive organs consist of two testes which lie widely separated in the same plane slightly anterior to the acetabulum. The left testis (LT) is oval measuring 0·13 mm. × 0·1 mm. while the right testis (RT) measures 0·1 mm. in diameter. The globular ovary (OV) situated immediately posterior to the acetabulum towards the left of the median line is 0·083 mm. in diameter. The genital pore (GP) is median, situated near the region of the intestinal bifurcation. These characters suggest that the larva belongs to the genus *Eumegacetes Looss*, 1900, of the family Lecithodendriidæ.

It has been sufficiently documented that lecithodendriid trematodes require various aquatic arthropods such as Diptera, Odonata and Coleoptera as second intermediate hosts. Life-history studies of some lecithodendriids are also available. Stafford[1] experimentally raised adults of *Eumegacetes medioximus* in chicken from metacercariæ occurring in *Gomphus externus* and *G. plagiatus*. On the other hand, Hall[2] who encountered metacercariæ of *Eumegacetes* sp. in various naiads taken from rivers at Indiana and Michigan could not succeed in obtaining the adults experimentally in chicken. Our knowledge of the adult species of the genus *Eumegacetes* which occur in various birds in India has been summarised recently by Jaiswal and Vasudev.[3] However, there does not appear to be any information on their metacercarial stages; it was thus felt desirable to make a record.

One of us (R. M.) thanks the University Grants Commission for a scholarship. We are grateful to Professor P. N. Ganapati for facilities.

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BIOVULAR FOLLICLE AND BINUCLEAR OOCYTE IN FIVE-BANDED SQUIRREL

The occurrence of an ovular and polyovular follicles and poly-nuclear oocytes in the ovaries of some of the mammals is well known.[1–15] But it has never been reported in the five banded squirrel (*Funambulus pennanti*), in which polynuclear oocytes are rare, whereas polyovular follicles, although common in embryonic or immature ovary, occur with less frequency in the adult.

Recently, in the left ovary of a squirrel with advanced extra-uterine pregnancy both the binuclear condition of an egg and also the presence of biovular condition of the follicle have been observed. This ovary shows follicular atresia and the presence of a number of primary oocytes. This condition has not yet been reported in the animal, although this is used in large numbers in a number of schools. This indicates that it must be of rare occurrence in these animals. Since noticing it in this female, we examined our earlier material but have failed to observe it even in pregnant females. Therefore, the occurrence of both these conditions, *viz.*, biovular or polyovular follicle and binuclear ova in this abnormal female with an extra uterine pregnancy makes it of great interest.

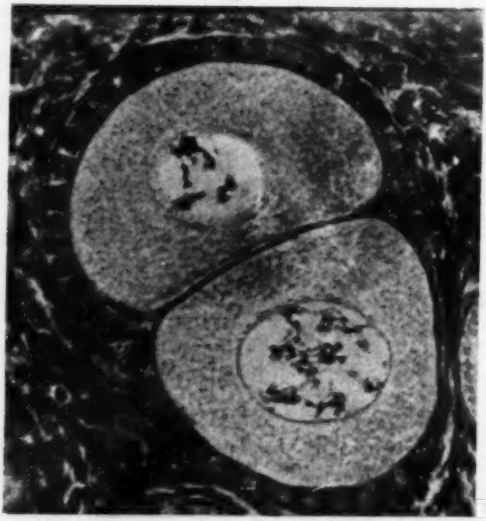

FIG. 1. Biovular follicle, × 580. Fixed in Bouin and sections at 6-μ stained in Harris Hæmatoxylin and Eosin.

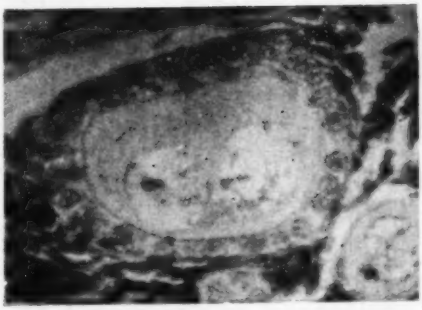

FIG. 2. Binuclear oocyte, × 509.

In the biovular follicle both the oocytes lie in direct contact with each other (Fig. 1), are of equal size and are covered over by a common granulosa membrane. The binuclear oocyte is present in the same ovary. The nuclei appear exactly similar, both in shape and size, and are present in a single oocyte with uniform cytoplasm (Fig. 2). Although the material does not permit us to state with certainty as to the origin of polyovular and polynuclear ova, yet an examination of the sections of the ovary of this animal seems to favour the theory of the fusion of two or more adjacent uninuclear germ cells for the binuclear condition of an egg and concresence of the adjacent follicles for the biovular condition.

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A NOTE ON THE EFFECT OF FAST NEUTRONS ON THE SEXUALITY IN CASTOR

DRY seeds of HC. 1 castor were irradiated predominantly with fast neutrons in the atomic pile at the Apsara Atomic Reactor, Trombay (India), in 1959. The different doses of fast neutrons used were :—

Fast neutrons (integral flux)	Gamma contamination
$2{\cdot}5\times10^{12}$ *n*/cm.²/sec.	$1{\cdot}25\times10^{4}$ *r*
5×10^{12} *n*/cm.²/sec.	$2{\cdot}5\times10^{4}$ *r*
1×10^{13} *n*/cm.²/sec.	5×10^{4} *r*
5×10^{13} *n*/cm.²/sec.	$2{\cdot}5\times10^{5}$ *r*

HC. 1 castor is an improved variety much under use in Andhra Pradesh, India. The typical HC. 1 castor strain is characterised by having a few (about 30%) male flowers at the base and the rest female flowers above on the raceme.[1] With the object of exploring, beneficial mutations that could be used in plant breeding programmes, the study of the irradiated seeds of HC. 1 castor was undertaken in this department.

The behaviour of the M_1 seed was studied during 1959 and several morphogenetic and cytological effects of radiation were noticed (paper under publication). Regarding the effect on the sexuality observed in the M_1 population, only one plant from the treatment with 1×10^{13} *n*/cm.²/sec. showed a 100% pistillate raceme with one bisexual flower at the base. The progeny of this plant in the M_2 generation showed a general tendency for minimum number of male flowers and some in particular showed a few bisexual flowers on the primary raceme.

M_2 generation of the irradiated material was sown inflorescencewise in 1960 and the results regarding the variations in the sexuality proved very interesting. The progeny of the seeds treated with $2{\cdot}5\times10^{12}$ *n*/cm.²/sec., 5×10^{12} *n*/cm.²/sec. and 1×10^{13} *n*/cm.²/sec. have shown many plants with various gradations in the percentage of female flowers on the racemes, including a good number of 100% female ones as shown in Table I.

Such influence of neutron radiation on the sex ratio increasing the number of female flowers, has been observed in *Citrullus vulgaris* (Water melon), another monœcious plant.[2]

But, increase in the percentage of male flowers on the raceme including 100% male racemes, has also been observed in the M_2 generation of the neutron irradiated HC. 1 castor as shown in Table II.

TABLE I

Neutron dosages	Plants with 92–98% female flowers on the primary raceme	With 3 male flowers only in the primary raceme	With 2 male flower on the primary raceme	With 1 male flower on the primary raceme	100% female on the primary raceme only	100% female on the raceme of 1st and 2nd order only	100% female on all spike	Total number of plants studied
$2{\cdot}5\times10^{12}n/cm^2/sec.$ ..	59	2	2	8*	4	3	5	1271
$5\times10^{12}n/cm^2/sec.$ ..	63	2	1	1	2	Nil	Nil	795
$1\times10^{13}n/cm^2/sec.$ ..	62	7	6	4	5	Nil	6†	521
Control ..	Nil	Nil	Nil	Nil	Nil	Nil	Nil	30

* In this group out of the 8 plants mentioned 4 were having a bisexual flower each, instead of a single male flower. † The six 100% female plants mentioned are all the progeny of a single parent.

The control plants on average had 3 racemes per plant and the pistillate plants on average, had 5·4 racemes per plant. The number of flowers per raceme vary according to the order of the raceme.

TABLE II

Neutron dosages	Plants showing 75–80% male flower on the racemes	80–90% male flowers on the racemes	90–95% male flower on the racemes	2 female flower only on the primary raceme	100% male on the primary raceme	Total No. of plants studied
$2{\cdot}5\times10^{12}n/cm.^2/sec.$ ..	67	8	1	1	Nil	1271
$5\times10^{12}n/cm.^2/sec.$ ..	13	2	2	1	Nil	795
$1\times10^{13}n/cm.^2/sec.$ ..	8	3	Nil	Nil	1	521
Control ..	Nil	Nil	Nil	Nil	Nil	30

Most of these dominantly male plants and the 100% male plant come under 3 distinct parental groups.

How far these variations in the sexuality of HC. 1 castor induced by neutrons are genetic or non-genetic[3] is to be ascertained on further study. Meanwhile, the 100% female racemes are crossed with the typical HC. 1 strain and 100% male raceme as pollen parents to observe the behaviour in subsequent generations.

However, the 100% pistillate racemes induced by fast neutron radiation if they are not reversible, may prove very useful for the study of hybrid vigour and multiplication of hybrid castor seed on a commercial scale.[4]

The authors thank Dr. H. A. Razvi, Principal and Professor of Agricultural Botany, for his keen interest in the work and providing facilities.

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BINUCLEATE POLLEN MOTHER CELLS IN *CLITORIA TERNATA*

AN up-to-date list of the reports on the occurrence of sporadic binucleate pollen mother cells in 34 different plant materials since 1909 has been compiled by Kamra (1960). In normal and mutant barleys he showed that such occurrence is not as rare a phenomenon as is generally assumed, and about 2-4% of all P.M.C. studied were binucleate. Trinucleate and quadrinucleate P.M.C. were also seen. The origin of binucleate condition was attributed to the failure of cell-wall formation at premeiotic mitosis.

Binucleate pollen mother cells were seen in *Clitoria ternata* at a very low frequency. They were mostly synchronized in meiotic division cycle, but one of the nucleus was always seen to be smaller than the other. Of the six binucleate cells observed so far in no one meiosis proceeded beyond early diakinesis stage. But degeneration of one of the nuclei of the binuclate cell as observed by Holden and Mota (1956) in *Avena* hybrid could not be seen in this plant.

Photomicrograph of one of the binucleate cell with both the nuclei at pachytene is given to add one more plant with sporadic binucleate P.M.C. The photomicrograph also shows that

the pachytene chromosomes of *Clitoria ternata* are well differentiated and some of them can be followed from end to end. The detailed

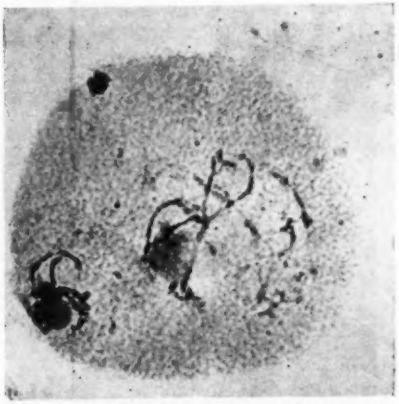

FIG. 1. A binucleate cell with both the nuclei at pachytene, one nucleus smaller than the other. All the eight differentiated pachytene bivalents can be seen.

morphology of the pachytene chromosomes in the complement is being published elsewhere.

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SIMULTANEOUS OCCURRENCE OF *TILLETIA FOETIDA* (WALLR.) LIRO AND *ANGUILLULINA TRITICI* (S.) G. BEN. IN THE SAME EAR AND GRAINS OF WHEAT IN PAURI-GARHWAL, UTTAR PRADESH

THE simultaneous presence of the bunt and smut fungi in wheat heads has been observed by a number of workers. Maire[1] observed the simultaneous occurrence of *Anguillulina tritici* (S.) G. Ben (*Tylenchus tritici*) and *Tilletia caries* (DC) Tul. (*Tilletia tritici*) in wheat heads and Bedi *et al.*[2] recently reported the simultaneous occurrence of *Ustilago tritici* (Pers.) Rost. and *Anguillulina tritici* (S.) G. Ben. in a single ear of wheat.

An interesting observation was recently made in the rabi season of 1960 on an ear-cockle affected wheat field in Pauri-Garhwal in Uttar Pradesh. Normally ear-cockle of wheat caused by *Anguillulina tritici* thrives best on the plains of Uttar Pradesh and its occurrence is uncommon in the hilly district of Pauri-Garhwal where true bunt caused by *Tilletia fœtida* requiring a lower optimum temperature is more common. The association of these two widely different micro-organisms is both rare and interesting. It was observed that more than half of the ears of wheat were almost totally infected by the true bunt causing fungus, *Tilletia fœtida*, whereas the top portions were affected by the ear-cockle disease bearing nematode galls visible between the glumes. Intermediary stages were also found where a nematode gall was filled with bunt spores or the bunt balls were infested with nematodes. Such an association of *Tilletia fœtida* and *Anguillulina tritici* appears to be a new record for Uttar Pradesh and India.

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WILTING OF BIG RAIN TREES IN CALCUTTA

DEATH of well-grown Rain trees (*Enterolobium saman* Prain) has been noticed in various parts of Calcutta (Padmapukur roadside area, North Calcutta park, Calcutta Maidan, etc.) beginning from May 1959. In all, more than 32 trees were casualties. The trees were all big, 60-80 years old and were characterised by the barks of their main trunks being stripped bare of leaves but the trees themselves remained firmly rooted to the ground and they were so hard and rigid that they withstood uprooting by a strong evening gale (90 m.p.h.) last May.

We prepared by standard methods pure cultures of *Fusarium* species from roots of the affected trees supplied by courtesy of Mr. P. C. Muzumdar, Commissioner of the Calcutta Corporation. Two subcultures in potato dextrose agar media sent by air were kindly identified by Dr. W. L. Gordon, Plant Pathologist, Manitoba, Canada, as *Fusarium solani* sensu Snyder and Hansen.

Fusarium solani has been reported from tropical soils affecting shisham (*Dalbergia sissoo* Roxb.), guava (*Psidium guava*, L.), etc., and ultimately killing them while Das Gupta[1] recorded variations in the number of *Fusarium* colonies with the season.

Pathogenicity tests on 3-month old seedlings from trees carried out by us showed that 5 out of 11 seedlings infected by us died about 1½ months after infection. We re-isolated *F. solani* from the roots of the dead seedlings. Section of the affected roots showed brown colour in the xylem area and the presence of hyphæ. Inoculation of roots of about one year plants were unsuccessful.

It would appear that the ultimate wilting and death of these trees is due to root infection by *F. solani* though the upper parts of dead shoots may harbour other fungi. We had no opportunity of tracing the earlier stages of the disease due to lack of material.

According to Garret,[2] death is due to the blocking of xylem vessels—not so much by mycelium as by a gum-like toxin, thermostable and dialysable. Such a secretion would also account for the rigidity of the trunk of the dead tree.

Verma[3] considers that trees beyond a certain age exhibit decreasing resistance to infection, thus explaining casualties from the same age-group. For control of the disease, Bakshi[4] suggests intermittent flooding of the soil while Chauhan[5] recommends treatment of the soil with finely ground mustard oil-cake powder.

We suggest both methods be tried for control of *Fusarium* wilt.

Dept. of Medical Mycology, School of Tropical Medicine, Calcutta and State Agri. Res. Inst., Calcutta, *March* 7, 1961.

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OCCURRENCE OF INTRACORTICAL ROOTS IN *BAMBUSA*

The roots of *Bambusa arundinacea* are typically polyarch and usually show numerous air-spaces in the middle cortex. A new feature of these roots noticed by us is the occurrence of intracortical root branches which instead of coming out at right angles from the parent root travel vertically downwards through some of the air-spaces in its cortex (*see* Fig. 1). In some sections, some of these intracortical roots are seen to give rise to lateral branches while they are still enclosed in the cortex of the parent root and these branches too travel vertically downwards through the cortex of the first root. The thinner branches show root hairs spreading out in the cortical air-spaces. The structure of the intracortical roots is like that of the ordinary roots of this plant.

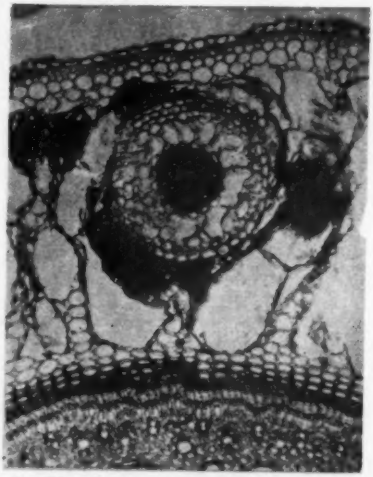

Fig. 1. Root of *Bambusa arundinacea* showing intracortical root and its branches (dark patches), × 102.

The occurrence of intracortical roots in *Bambusa arundinacea* is being reported here for the first time although they occur in some other monocotyledonous plants, *e.g.*, some Bromeliaceæ[1] and *Asphodelus tenuifolius*.[2] Detailed work on the origin and course of these roots is in progress and will be published later.

We are thankful to Messrs. K. N. Singh and D. Banerji for giving us some sections of these roots.

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TWO FERN RUSTS FROM INDIA

Records of rusts on ferns are rare in India. Lately as a result of study of some fern rust collections, one new species of *Uredinopsis* and a new host record for *Hyalopsora polypodii* (Diet.) Magnus have come to light, the account of which is given in this paper. The specimens have been deposited in the *Herbarium cryptogamæ indiæ orientalis*, New Delhi, and indicated by H.C.I.O. numbers in the text.

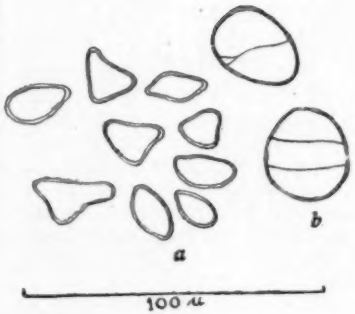

FIG. 1. *Uredinopsis syngrammes*. *a*, Uredospores; *b*. Teliospores.

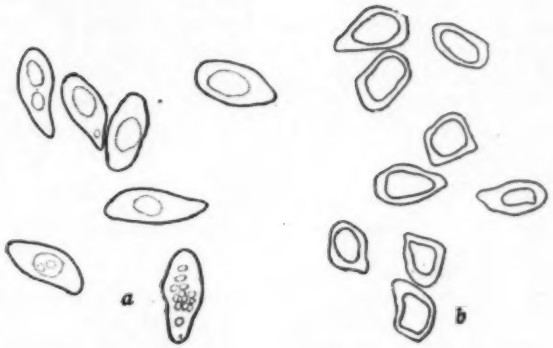

FIG. 2. *Hyalopsora polypodii*. *a*, Uredospores, × 405; *b*, Amphispores, × 330.

1. *Uredinopsis syngrammes* spec. nov. (FIG. 1)

Uredia hypophylla, subepidermalia, dispersa in maculas discoloras ambitus indefiniti, ut plurimum lineares limitatas nervis, rotundas, 0·4–0·9 mm. diameter, luteolas, postea evadentes brunneas vel etiam alutaceas. Peridium convexum, incolorum, tenue; cellulæ peridiales isodiametrice vel irregulariter polygonales, 9–11 × 12–13 (14) μ, parietibus usque ad 1·5 μ crassis; uredosporæ hyalinæ, brevissime pedicellatæ, sorum totum implentes, cordiformia vel femuriformia, nonnullæ ellipticæ vel subcylindricæ, symmetricæ vel asymmetricæ 16–28 × 10–20 μ, ut plurimum 19–23 × 11–18 μ; sporarum parietes incolori, leves, usque ad 2 μ crassi. Telia diffusa, amphigena, ut plurimum hypophylla, in maculis purpurascentibus fusce brunneis irregularibus linearibus; teliosporæ subepidermales, intercellulares, dispersæ sed ut plurimum laxe aggregatæ in seriem unam, incoloræ vel pallide luteolæ, subsphæroideæ vel ellipsoideæ, 2–5-cellulatæ, raro unicellulatæ, 35–42 × 28–30 μ, parietibus levibus, 1–1·5 μ crassis.

In foliis viventibus *Syngrammes fraxineæ* Bedd. [*Coniogrammes affinis* (Wall.) Hieron] ad Narkanda, 2,300 m. supra mare altit. 17 Octobris 1958 D.P. Mishra. Typus.

Uredia hypophyllous, subepidermal, pustular, scattered on discoloured spots of indefinite extent which are usually linear and delimited by veins, round, 0·4–0·9 mm. in diameter, yellowish, later brownish or even light tan-coloured; peridium convex, colourless and delicate; peridial cells isodiametrically to irregularly polygonal, 9–11 × 12–13 (14) μ with walls up to 1·5 μ thick; uredospores hyaline, very short stalked, filling completely the sorus, heart to femur head-like, some elliptic to subcylindric, symmetrical to asymmetrical, 16–28 × 10–20 μ (mostly 19–23 × 11–18 μ); spore walls colourless, smooth, up to 2 μ thick; telia diffuse, amphigenous but hypophyllous on brownish to purplish dark brown-coloured irregular linear spots; teliospores subepidermal, intercellular, scattered but mostly loosely aggregated in a single layer, colourless to light-yellow, subsphæroid to ellipsoid, 2–5-celled, rarely one-celled, 35–42 × 28–30 μ, wall thin, about 1–1·5 μ thick.

On leaves of *Syngramme fraxinea* Bedd. = *Conigramme affinis* (*Wall.*) Hieron. Narakanda (9,000 ft. above sea-level). 17-10-1958, D. P. Mishra (H.C.I.O. No. 26832) Type; 12-11-1959, M. M. Payak (H.C.I.O. No. 26831).

Hiratsuka (*Bot. Mag. Tokyo*, 1934, 48, 45) described *Milesina coniogrammes* on *Coniogrammes intermedia* from Japan. So far, as we are aware, this appears to be the only record of rust on this fern genus. Through the kind courtesy of Dr. N. Hiratsuka we were able to examine three collections (Y. Yoshida, 1932; N. Hiratsuka, 1938 and 1939) which revealed that it is quite distinct from the species described above in shape as well as size of the uredospores. In *M. coniogrammes*, uredospores are obovate to fusiform and measure 24–45 × 15–22 μ whereas in our specimen they are heart-shaped to femur-head-like. We were not able to locate any teliospores on the specimens from Japan.

2. *Hyalopsora polypodii* (Diet.) Magnus (Fig. 2) *in Ber. Deutsch. Bot. Ges.*, 1901, 19, 582 (Fig. 2)

This rust produces almost rounded, orange-yellow-coloured pustular uredia scattered or sometimes aggregated on both the leaf surfaces and measure up to 0·5 mm. in diameter. Uredospores are mostly ellipsoidal or oblong 20–35 × 12–16 μ in size; epispore is thin, hyaline and smooth. There are 4 germ pores which are

arranged equatorially ; spore contents are orange-yellow. Amphispores are also present which are much variable in shape, subglobose, ovate or polygonal due to mutual pressure and are 20–35 × 16–20 μ in size ; epispore is rather thick, almost smooth measuring 2–6 μ. Telia were not seen.

On leaves of *Diplazium japonicum* (Thbg.) Bedd., Darjeeling, 20-11-1959, S. P. Raychaudhuri (H.C.I.O. No. 26846).

Hyalopsora diplazii Hiratsuka (*Jour. Jap. Bot.*, 1940, **16**, 613), recorded on this host genus from Japan is quite different from this species in having much larger uredospores (23–41 × 15–23 μ) with conspicuous verruculose epispore.

Sincere thanks are due to Dr. R. S. Vasudeva, Head of the Division of Mycology and Plant Pathology, for his keen interest and encouragement ; also to Prof. N. Hiratsuka of Japan for confirming identity of new species. We are indebted to Dr. B. L. Chona, Mycologist, for his valuable guidance ; to Dr. H. Santapau, Head of the Biological Department, St. Xavier's College, for rendering the Latin diagnosis of new species and to Dr. P. N. Mehra, Head of the Botany Department, Punjab University, for identification of fern host (*Diplazium japonicum*).

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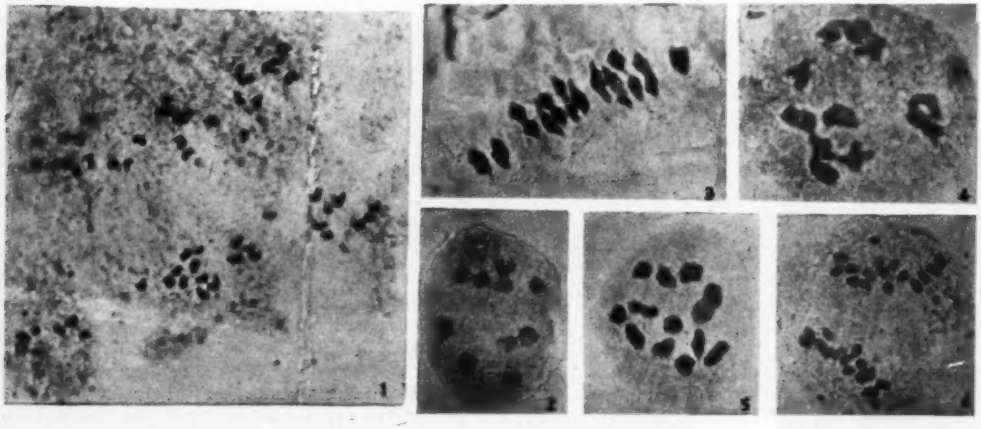
CYTOLOGICAL OBSERVATIONS ON THE INDIAN SPECIES OF COMMELINACEAE

THE family Commelinaceæ has a wide range of distribution, and about 70 species comprising of 9 genera are known to grow wild in different parts of India. In view of the wide range of variations and also of the occurrence of closely similar intermediate forms, the classification and delineation of species by earlier workers[1–3] needs revision. A detailed revision of the Indian species of the family supplemented by anatomical and cytological data is at present being carried out.[9,10]

In this report chromosome numbers of 15 species (excluding one variety) comprising of 3 genera have been recorded, following the normal aceto-carmine squash technique. Herbarium specimens of all the species collected are available in the Western Circle of the Botanical Survey of India, Poona.

All the 5 species of *Commelina* Linn. examined have a regular meiosis, and revealed numbers in a multiple series of $x = 15$. Meiotic studies have been made on *Commelina subulata* ($n = 30$) and *C. hasskarlii* ($n = 45$) for the first time. *C. subulata* which has not been so far collected from the Western Ghats has now been recorded from several localities between Dharwar and Khed (Poona District). In one plant of *C. paludosa* collected from Poona, 60 clear bivalents were counted at metaphase I, thus confirming the existence of polyploid races in the different ecotypes of this species.



FIGS. 1–6. Fig. 1. *Murdannia simplex* (*n*=30, A I). Fig. 2. *M. semiteres* (*n*=10, M I). Fig. 3. *Cyanotis fasciculata* (*n*=12. M I). Fig. 4. *C. cucullata* (*n*=10, late diakinesis). Fig. 5. *C. tuberosa* var. *adscendens* (*n*=12, M I). Fig. 6. *Commelina diffusa* (*n*=15, A I). (Magnification, × 1,800).

TABLE I

Results on the various species of Commelinaceæ investigated

Sl. No.	Name of species	Locality	Present observations	Previous observations
1	*Commelina forskalei* Vahl ..	Mukteshwar (Maharashtra), 65805; Poona, 64542 and 64560	$n=15$	$2n=28$[8], 30[7]
2	*C. diffusa* Burm. f. (= *C. nudiflora* auct. non Linn.)	Agumbe (Mysore), 68088	$n=15$	$2n=28$[6,8], 30[4,5], 56[4,6]
3†	*C. paludosa* Bl. (= *C. obliqua* Ham. ex Don)	Poona, 64939	$n=60$	$2n=45$, 60[6], $2n=100$, 150[5]
4*	*C. hasskarlii* Cl. ..	Poona, 65948	$n=45$	..
5*	*C. subulata* Roth ..	Gargatwadi, Khed Taluk (Maharashtra), 66273	$n=30$	..
6	*Cyanotis axillaris* (Linn.) R. & S.	Poona, 64715; Agumbe (Mysore) 67828 and 67879	$n=10$	$2n=20$[4,5,7]
7*	*C. cucculata* Kunth ..	Ghavar (Maharashtra) 68547	$n=10$	..
8	*C. cristata* (Linn.) D. Don ..	Poona, 64715; Agumbe (Mysore),	$n=12$	$2n=24$[4,5,7]
9*	*C. fasciculata* R. & S. ..	Poona, 64265 64589 and 64639	$n=12$	..
10*	*C. tuberosa* R. & S. ..	Mahabaleshwar, 67711	$n=36$	..
11*	*C. tuberosa* R. & S. var. *adscendens* Cl.	Poona, 64528	$n=12$	..
		do. 64564	$n=24$	
12*	*Murdannia pauciflora* (Wt.) Brück. (= *Aneilema pauciflorum* Wt.)	Agumbe (Mysore), 67851	$n=10$	..
13†	*M. simplex* (Vahl) Brenan (= *A. sinicum* Ker-Gawl. incl. Lindl.)	do. 67527	$n=30$	$n=20$ and $2n=40$[7]
14†	*M. spirata* (Linn.) Brück. (= *A. spiratum* R.Br.)	do. 68018	$n=9$	$2n=20$[6], 40[4]
15*	*M. ochracea* (Dalz.) Brück. (= *A. ochraceum* Dalz.)	do. 68025	$n=18$	..
		Mahabaleshwar, 67575	$n=30$	
16*	*M. semiteres* (Dalz.) Santapau (= *A. paniculatum* Wall.)	Agumbe (Mysore), 67837	$n=7$	
		Bhimashankar (Maharashtra), 66247	$n=10$	
		Matheran (Maharashtra), 64355	$n=20$	

* Chromosome numbers recorded for the first time. † Haploid numbers differing from previous observations.

It is interesting to observe that both *Cyanotis axillaris* and *C. cucculata*, whose taxonomic position needs further scrutiny, have a diploid complement of $2n=20$ only, whereas all the other Indian species of *Cyanotis*, investigated so far, have a basic number of $x=12$.[4-7] The highest number recorded so far in this genus is $n=36$ for *C. tuberosa*.

The present study on the genus *Murdannia* Royle has shown the existence of polyploid and aneuploid types in the various geographical races of the same species. The various species of *Aneilema* R. Br. and *Murdannia* are being studied in detail, to understand the affinity between these two genera, and to observe how far Brückner's[2] splitting up of the genus *Aneilema* is justified by cytological and other evidences.

Results of the observations are recorded in Table I.

Western Circle, Bot. Survey of India, Poona-1, *April* 4, 1961.

R. S. RAGHAVAN.
SESHAGIRI RAO ROLLA.

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3. Brenan, J. P. M., *Kew Bull.*, 1952, 179.
4. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas of Flowering Plants*, George Allen & Unwin Co. Ltd., 1955, 339.
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GIBBERELLIN INDUCED PARTHENOCARPY IN GUAVA (*PSIDIUM GUAJAVA* L.)

BALASUBRAMANYAM AND RANGASWAMI[1] recently reported parthenocarpy in guava induced by 'pollen hormone'. Gibberellin is a well-known agent for producing parthenocarpic fruits, and in this note are reported some interesting results obtained by inducing parthenocarpy in guava by a potassium salt of gibberellic acid. This salt, referred to as GA in what follows, was supplied by the British Drug House, Bombay. The experiments were conducted on three-year old guava plants of the Allahabad Safeda variety. Unopen flowering buds were emasculated on the 23rd August 1960 and the following day aqueous solutions of GA in concentrations of 100, 500, 1,000 and 10,000 p.p.m. were mixed with lanolin paste and applied uniformly to 4 lots of 15 buds each. An equal number of control buds were allowed to grow normally or were treated with GA free lanolin.

Observations were taken at weekly intervals. Within 10 days of the experiment, control buds and buds treated with GA in concentrations of 100 and 500 p.p.m. dropped off without fruit formation. Small parthenocarpic fruitlets were formed in buds treated with 1,000 p.p.m. GA but these too dropped off within a month. When the fruitlets were cut open, a few brown shrivelled ovules were found.

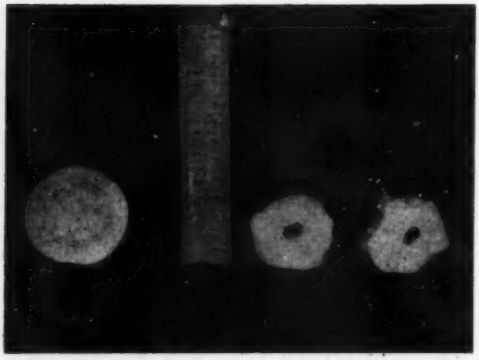

FIG. 1. Transverse sections of two parthenocarpic and one normal fruits of the Allahabad Safeda variety of guava.

Treatment of buds with GA, 10,000 p.p.m., gave the best results. Out of the 15 treated buds, 5 fruitlets grew to a size of 1·25 cm. diameter whereas the rest of the 10 buds produced parthenocarpic fruits which reached maturity 15 days earlier than the normal crop. The fruits were oblong with swollen calyx and ridges on the surface (Fig. 1). The fruit pulp was more granular than the pulp of the normal fruits. It was strawen in colour and had an ascorbic content of 726·7 mg. against 354 mg. per 100 gm. pulp of the normal fruits.

Govt. Fruit Research Station, Basti, Uttar Pradesh, *April* 11, 1961.

S. S. TEAOTIA.
I. C. PANDEY.
R. S. MATHUR.

1. Balasubramaniyam, V. R. and Rangaswamy, G., *Curr. Sci.*, 1960, **28**, 413.

A NEW SPECIES OF HAPLOSPORELLA FROM MAHARASHTRA

IN the course of her mycological collections, the writer encountered a member of the phæosporous Sphæropsidales on several bushes of *Nerium odorum* Soland. growing on dead leaves in the campus of the Law College, Poona. The fungus was identified as a species of Haplosporella, sensu Petrak and Sydow (1926-27). As the fungus is not previously reported on this host it is presented here as a new species as follows :

Haplosporella neriicola SPEC. NOV. KALANI

Infectionis maculæ epiphyllæ, circulares, verrucosæ, elevatæ, dispersae, nigræ ; stromata separata, verrucæ, similia, fortiter evolute supra, immersa, postea evadentia erumpentia, fusca, carbonacea, globosa vel pulvinata, 209–570 × 228–760 μ Pycnidia aggregata, 3–7 in singulis stromatibus, immersa in cateryas botryosas, nigra, obtuse papillata, singula 76–190 × 38–380 μ. Conidiophori, simplices, breves, continui hyalini, laxe dispositi, 4·2 μ longi ; conidia ovoidea vel oblonga, alte brunnea, orassis parietibus prædita, 1-cellularia, insidentia singula 17 = 8·5 μ. Hyphæ steriles plures.

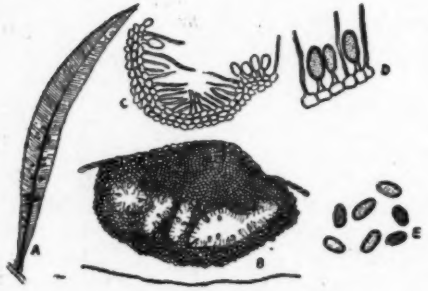

FIG. 1. *A*, Habit, × natural size ; *B*, Section through stroma, × 30 ; *C*, Section through pycnidium, × 132 ; *D*, Conidiophores, conidia and sterile threads, × 20; *E*, Conidia, × 132.

Typus lectus in foliis emortuis *Nerii odorum* Soland. a I. K. Kalani ad Poona, in India mense novembri anni 1960.

The type is deposited at the Herbarium Cryptogamie, New Delhi, India and Kew, England.

This is the ninth record for Haplosporella from India.

The author is grateful to Prof. M. N. Kamat for his guidance and deep interest and to the Director of the M.A.C.S. for facilities given at the Institute. Grateful thanks are also due to Prof. H. Santapau for the Latin diagnosis.

M.A.C.S., (Miss) I. K. Kalani.
Poona-4, *April* 21, 1961.

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THE COMPOSITIONS AND THE ADAPTATION MODIFICATIONS OF POLISH LOESS MOSS FLORA

Studies regarding the composition, growth and the adaptation modifications of the moss flora specific to the loess area of the South-Eastern Poland were carried out during the years 1959-61. The loess land has a characteristic set of conditions for the growth of sporophyta and vascular plants. Although these conditions have a close resemblance to those found in the steppes, they exert much more influence upon the compositions and individual adaptation of the moss species growing on the loess lands than they do in the steppes (Gams, 1932 and Karczmarz, 1960, and 1961). The reasons underlying it are the high calcium carbonate contents (19·0%), and the amount of rainfall received by these areas in the spring and the summer. A few of the species growing in these areas are so-called calcifiling species, like *Aloina brevirostris*, *A. rigida*, *Barbula convoluta*, *B. cylindrica*, *B. fallax* (in the majority of cases var. *brevifolia*), *B. hornschuchiana*, *B. lurida* spp. *cordata*, *Barbula rigidula*, *Phascum curvicollum*, *Pottia bryoides*, *P. intermedia*, *P. lanceolata*, etc., a majority of which shows a special type of body structure and behaviour as a means of adaptation to the dry conditions found in loess areas, (i.e., Bryoxerogeophytia and Ephemerophytia). The first group, i.e., Bryoxerogeophytia, besides including a few acrocarpous moss species, like the species belonging to the genus *Acaulon*, *Aloina*, *Barbula*, *Pottia*, etc., also includes pleurocarpous species like *Brachythecium albicans*, *B. glareosum*, *Camptothecium lutescens*, *Campylium chrysophyllum* var. *Sommerfeltii*, *Thuidium abietinum* and *Th. recognitum*. The second group, i.e., Ephemerophytia, on the other hand, is formed by the acrocarpous species, like *Ceratodon purpureus*, *Erythrophyllum rubellum*, etc., and a few species belonging to the genus *Bryum*, *Catharinea*, *Dicranella*, *Fissidens*, *Funaria*, *Mniobryum*, *Phascum*, *Pohlia* and *Pottia*.

On the loess hills having a southern exposition the xerotermical community of *Tortula velenovskyi* is found to grow. The moss species belonging to this community have a special adaptation, though in very mild forms, to the dryness and high amount of sunshine. Highly adaptable to dryness are the species belonging to the family Pottiaceæ (Pan-Chien, 1942). A minority (nearly 27·0%) of the moss species growing on loess land in Poland (115 species in all) represents mediterranean elements. The species specific to the Central European loess areas, like *Tortula velenovskyi*, represent, on the other hand, pannonic elements.

The distribution of spores is brought about either by the agency of winds (anemosporia), water (hydrosporia) or insects (zoosporia), and depending upon the circumstances any one of these species can make use of either or all of these helping agents.

Dept. of Systematic Botany, and Plant Geography, Maria Curie Skodowska University, Lublin (Poland), *June* 12, 1961. K. Karczmarz.

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REVIEWS

Tables of the Riemann Zeta Function. By C. B. Haselgrove and J. C. P. Miller. (Published by the Royal Society at the University Press, Cambridge), 1960. Pp. xxii + 80. Price 50 *sh.* net.

The Riemann Zeta function $\zeta(s)$ is defined by the series $\zeta(s) = \sum_{1}^{\infty} \frac{1}{n^s}$ for Ri. $s > 1$. Ever since Riemann described it a century ago, this function has been studied intensively and its interest is still not exhausted in view of the challenges which some of the unproved conjectures regarding the zeroes of the zeta function pose to the mathematicians. The behaviour of the zeta function is notorious for its irregularities and from the numerical point of view, it is very difficult to compute. It was not until the advent of electronic computing machines that it was possible to compute the function for more than a few small values of the argument.

The present tables give values of $\zeta(s)$ and related functions to six decimals for values of s on the 'critical line', that is $s = \frac{1}{2} + it$, and on the line $s = 1 + it$ for $0 \leqslant t \leqslant 100$.

Values of the signed modulus $Z(t) = \pm |s(\frac{1}{2} + it)|$ are given for $t = 0\ (0{\cdot}1)$ 1,000 and for four short ranges of t, two near 7,000 and 17,000 where certain peculiarities are exhibited and two near 100,000 and 250,000 as typical ranges for large arguments.

The numerical values in the tables have already been used in a disproof of the conjectures of Polya and Turan. Inspection of the tables will lead to closer knowledge of this fascinating function and will encourage further conjectures about its behaviour. K. S. V.

Mechanics, Second Edition. By Keith R. Symon, University of Wisconsin. (Addison-Wesley Publishing Company, Inc.), 1960. Pp. XIV + 557. Price $ 10.50.

The present edition (1960) of the book contains the following twelve chapters:

Chapter 1: Elements of Newtonian Mechanics; Chapter 2: Motion of a particle in one dimension; Chapter 3: Motion of a particle in two or three dimensions; Chapter 4: The motion of a system of particles; Chapter 5: Rigid bodies, Rotation about an axis, Statics; Chapter 6; Gravitation; Chapter 7: Moving co-ordinate systems; Chapter 8: Introduction to the mechanics of continuous media; Chapter 9: Lagrange's equations; Chapter 10; Tensor Algebra, Inertia and Stress tensors; Chapter 11: The rotation of a rigid body; Chapter 12: Theory of small vibrations.

The last three sections of Chapter 9 dealing respectively with the Lagrange's equations for the vibrating string, Hamilton's equations and Liouville's theorem and the Chapters 10, 11 and 12 are the additions over the first edition (1953).

In these twelve chapters the author builds up the subjects of Mechanics from fundamental principles up to the standard required for the undergraduate students of the American Universities intending to proceed to advanced studies in Physics. Keeping this purpose in view, the author includes at proper places brief but clear discussions of the mechanical problems associated with some of the physical topics like harmonic oscillator, two coupled harmonic oscillations, central orbits, Rutherford scattering by a charged particle of finite mass, the two-body problem, the restricted three-body problem, normal modes of oscillations, Betatron oscillations in an accelerator. In fact one of the characteristic features of the book is that the author sets a problem in a general way and then derives from it as particular cases the physical problems of diverse nature. The approach not only provides the reader with information about these physical problems, but also brings out clearly the universal applicability of a mathematical method.

The book is more or less self-sufficient as it provides also the necessary knowledge of the mathematical tools like vectors and tensors.

P. L. BHATNAGAR.

The Real Projective Plane, Second Edition. By H. S. M. Coxeter. (Cambridge University Press), 1960. Pp. viii + 226. Price 18 *sh.* 6 d.

This is an introductory university text-book on projective geometry, including a thorough treatment of conics and a rigorous presentation of the synthetic approach to co-ordinates. The restriction to real geometry of two dimensions makes it possible for every theorem to be adequately represented by a diagram. The subject is used to illustrate the development of a logical system from primitive concepts and simple

axioms. Accordingly the treatment is mainly synthetic : analytic geometry is confined to the last two of the twelve chapters. The eighth and ninth chapters show how projective ideas can be used as a basis for metrical geometry.

In this second edition, several errors contained in the first edition have been corrected. There is an improved treatment of degenerate polarities, of the inside and outside of a conic, of the condition under which a quadrangle may be convex with respect to a line, and of Klein's classification of geometrics according to the groups of transformations under which their properties are invariant. V.

Theoretical Physics in the Twentieth Century —A Memorial Volume to Wolfgang Pauli. Edited by M. Fierz and V. F. Weisskopf. (Interscience Publishers, New York), 1960. Pp. x + 328. Price $ 12.00.

This book comprises of a series of articles written by eminent scientists on topics that were either inspired by or are associated with Pauli's work. It was originally intended to be a commemoration volume to celebrate the 60th birthday of Pauli, but unfortunately it ended as a memorial volume since the untimely death of Pauli occurred in the meantime. Pauli made a name for himself even at an age of twenty by writing an article on relativity theory in the *Encyclopedia*, and this even today stands as one of the best expositions on the subject. Pauli's best known works are the Exclusion Principle and the Neutrino Hypothesis but a perusal of this in the bibliography of Pauli given at the end of the volume will indicate the width of his interests.

The book starts with a brief foreword by Professor Niels Bohr who writes on the contributions of Pauli to physics. The other contributors to the volume are Kronig, Heisenberg, Wentzel, Villars, Peierls, Fierz, Landu and C. S. Vu. Some of the articles have a personal and historical touch, but practically all are reviews on topics that were stimulated by Pauli's contributions. The book will provide a very interesting reading to all physicists.

An Introduction to Astrodynamics. By R. M. L. Baker, Jr. and M. W. Makemson. (Academic Press, Inc., New York-3), 1960. Pp. xiv + 358. Price $ 7.50.

With the advent of artificial satellites, space vehicles, and interplanetary stations astrodynamics has come to the forefront as a separate branch of celestial mechanics with a practical bias. In a restricted sense, astrodynamics may be defined as the engineering or practical application of celestial mechanics to the contemporary problems of space vehicles and their trajectories. At present there exists no text-book of an introductory type that can be used for teaching at college level on this subject which is growing in importance.

The book under review is meant to serve this purpose and the approach is more specific than general.

The book is broadly divided into two parts, the first part dealing with fundamentals include chapters on minor planets, comets, geometry and co-ordinate systems, and various constants coming under the categories geocentric, selenocentric, heliocentric, and planetocentric which are required to predict orbits of space vehicles. The second part includes chapters on orbit determination, the n-body problem, perturbations, and non-gravitational and relativistic effects. There is also a chapter on observation theory dealing with the requirements of rapid and accurate observation of space vehicles by optical as well as electronic instruments. The last chapter deals with the application of theories developed in earlier chapters to the particular case of interplanetary orbits. Students will find the exercises given at the end of the book useful to guide their understanding of the text. A. S. G.

X-Ray Microscopy. By V. E. Cosslett and W. C. Nixon. (Cambridge University Press, London, N.W. 1), 1960. Pp. xiv + 406. Price 80 *sh.*

Although the possibilities of using X-rays for microscopical investigations have been known for sometime, it is only within the last few years that X-ray microscopy has become a practicable research tool. The two characteristic properties of X-rays, namely, their short wavelengths and their high penetrating power (having no charge as contrasted to electron beams), make them peculiarly suitable for this purpose, and the useful range of X-ray microscopy in its various applications will bridge the gap between optical microscopy on the one side and electron microscopy on the other. In dealing with short wavelengths of high penetration several difficulties will have to be overcome, the chief among them being the method of focusing. Considerable research work is being done on the subject and the perfecting of the technique may be said to be still in the evolving stage. Literature on the subject is scattered in various journals and hence a consolidated review on X-ray microscopy will be a timely publication.

In this context the present book *X-ray microscopy* by Cosslett and Nixon, who themselves have made significant contributions in this field, will be welcomed by all those who employ this technique in their investigations.

The subject-matter of the book can be divided into three main parts: (1) Principles involved in the three main methods of X-ray microscopy, namely, Contact radiomicrography, Reflection microscopy, Point projection method; (2) Practical details in using the technique for qualitative and quantitative microscopic work; and (3) examples of applications in biology, medicine, metallurgy and technology. There are also chapters on the production of X-rays, and on microdiffraction procedures. The last chapter on new experimental methods describes amongst other things, different forms of image intensifiers, image conversion X-ray microscope, focusing by back-scattered and forward scattered electrons, and contact radiomicrography with electron microscope enlargement. The book contains 32 plates besides a large number of line diagrams.

The book will be generally welcomed by all X-ray microscopists and microanalysts, but from the point of view of its appeal to the general students the reviewer feels that the subject-matter of the book could have been better arranged, and also the book could have been made more self-contained by supplying essential information of a fundamental nature. To cite one example, the student-reader finds early in the book (Figures 1 and 3) that focusing is effected by electron lens. To know more about electron lens he consults the index which refers him to p. 273, where he is shown § 11·3 for a brief description, where again he is directed to References on p. 385 and p. 393 which give him the names of the standard text-books to be consulted on the subject. A. S. G.

Structure and Function of Muscle. Edited by G. H. Bourne, Vol. II. *Biochemistry and Physiology.* Pp. xiv. + 593. Price 118 *sh.* Vol. III, *Pharmacology and Disease.* (Academic Press Inc. (Lond.) Ltd., 17, Old Queen Street, London, S.W. 1), 1960. Pp. xiv + 489. Price 107 *sh.* 6 *d.*

The two volumes under review constitute the bulk of treatise of three volumes edited by Dr. G. H. Bourne and designed to cover in detail all aspects of current knowledge of muscle tissue. Twelve articles in the second volume relate to biochemistry and physiology of muscle, while in the third volume, there are thirteen articles dealing with pharmacology and disease of muscle.

The second volume opens with an article by A. C. Szent-Gyorgyi, wherein he discusses the characterization and reactions of the myofibrillar proteins, the amino-acid composition, end-group and sequence studies and polypeptide chain configuration of the fibrous muscle proteins. The biochemistry of muscular action is reviewed by D. M. Needham who gives a detailed account of the interaction of adenosine triphosphate and actomysin in muscle contraction and mechanism of action of Marsh factor in relaxation. The function of sarcosomes which are the respiratory granules of muscle, the mechanisms of energy-yielding reactions, the properties of the isolated sarcosomes are described by E. C. Slater.

In his article on the role of acetyl choline system in neuromuscular junction, David Nachmansohn gives a critical resumé of the present day knowledge and concepts concerning the mechanism of conduction of nerve impulses in general and on the basis of this information, makes an attempt to evaluate the differences and similarities of the properties and function of the acetyl choline system in synaptic and neuromuscular transmission. Special topics such as the thermodynamics and biophysics of muscle, the physiology of muscular exercise and physiology of the heart have been included.

In Volume III, the first two articles deal with the effect of drugs on smooth and striated muscle and on myocardial contractility. Among the subsequent chapters which deal with abnormal muscle, special mention may be made of subjects like the effect of nutritional deficiencies upon muscle, changes in muscle due to ageing and after death and clinical and genetic aspects of muscular and neuromuscular diseases. The volume is aptly concluded with some general comments on muscle by A. Szent-Gyorgyi who has made outstanding contributions to our knowledge of the mechanism of muscle contraction.

Research workers, teachers as well as students will find in these two volumes a mine of information on the biochemistry, physiology, pathology and pharmacology of skeletal, smooth and cardiac muscle. P. S. SARMA.

Indian Essential Oils—A Review. By A. K. Menon. (Council of Scientific and Industrial Research, New Delhi, India), 1960. Pp. viii + 89. Price Rs. 7·00. 10 *sh.*

The above book of 89 pages is a valuable publication of the progress made in the field of essential oils, aromatic chemicals and related spice oils industry mainly during the period 1946-59. This is a second report by the C.S.I.R.

in this field, the first of which was published in 1946, by P. A. Narielwala and J. N. Rakshit.

The present volume has dealt with, in all, 29 essential oils, 5 spice oils and 29 natural isolates, attars and aqueous products, all of which have been discussed in four chapters under appropriate headings. Details of cultivation of the oil-bearing plants and the methods of extraction of their perfumes are given in most of the cases along with the names of the authors, firms and institutions connected with the development and practice of these methods. Analytical data along with the chemical compositions of the oils are also given in many cases.

The most valuable part of this book is its almost exhaustive bibliography of 575 *plus* 5 original investigations published in India during the period from 1908 up to 1959.

The statistical data given as appendices on production, consumption, export and import of essential oils and related products in India are informative and revealing.

P. Ramaswami Ayyar.

Insulin—*British Medical Bulletin*, Vol. 16, No. 3. (Medical Department, British Council, London, N.W. 1), 1960. Pp. 175-264. Price 20 *sh.*

This monograph on 'Insulin' commences with an interesting historical survey of 'The development of Insulin' by Charles H. Best, one of the two co-discoverers of this hormone. "The elucidation of chemical structure of the insulin molecule" by Sanger is a lucid presentation of the sequential progress, culminating in the successful structural analysis of this polypeptide hormone, and reveals the chemical basis of the variations in insulins obtained from different species of animals. These pioneering studies have resulted in the application of similar techniques to the elucidation of the structure of other protein hormones. Harris details the chemistry of the pituitary polypeptide hormones, oxytocin, vasopressin, corticotropin and the melanocyte stimulating hormones. In the metabolic studies pertaining to the inactivation and degradation in tissues of insulin, glucogon and other peptide hormones, the technique of utilising "iodinated peptides with radioisotopes ^{131}I" has been employed.

In spite of extensive use of insulin over the last four decades, metabolism and mode of action of insulin is still far from clear. Radioactive tracer studies and other recently developed biochemical techniques have now been applied for the elucidation of these problems. The results obtained are reviewed in chapters on the action of insulin on carbohydrate, protein and fatty acid metabolisms.

The types of insulins commercially available with their scope and limitation in therapy and the illustrated account of 'reactions to insulin' present features highly interesting to clinicians. The need for a cautious approach to the use of sulphonamide derivatives and the diguarides and the likely laboratory finding of a normal or low blood sugar level with severe acidosis and ketosis has been emphasized.

M. Sirsi.

Sex Differentiation and Development. *Memoirs of the Society for Endocrinology.* No. 7. Edited by C. R. Austin. (Cambridge University Press), 1960. Pp. 198. Price 45 *sh.*

We welcome this volume on sex differentiation as a worthy successor to the series published by the Society for Endocrinology from time to time. This memoir embodies the proceedings of a Conference held in London in April 1958 to survey the state of knowledge of sex in its various forms and implications. The symposium deals with four main topics, namely, mechanism of sex determination, differentiation of germ cells, manifestations of sex and sexual anomalies. The very broad and comparative survey of sex in animals ranging from bacteria to man touches upon interesting aspects of manifestations of sex in honey-bees, crustacea, fish and higher vertebrates.

Dr. Butler gives a fascinating account of sex differentiation and castration effects in the honey-bee. He has pointed out that the presence of the queen bee through the agency of an 'external hormone' contained in the so-called 'Queen substance' inhibits the development of the gonads in other females. Genetic sex determination is a central theme in the contribution of a number of speakers. The possibility of controlling sex ratio at conception either by phenotypic differentiation of X and Y bearing spermatozoa or by electrophoretic separation has been discussed by Dr. Beatty and Dr. Lewin. This aspect of study has opened up a new field of research in the control of sex. Sexuality in bacteria has been discussed by Dr. Hayes with particular reference to the processes by which transference of genes from donor to recipient cells takes place. The use of sex chromatin as a marker for the determination of genetic sex has assumed considerable importance in the diagnosis of genital abnormalities. The application of this method for the recognition of the variations of Turner's syndrome and Kleinfelter's syndrome has been reviewed. It appears from

these discussions that gonadal dysgenesis can affect either chromosomal males or females; only such cases in which chromosomal sex is contrary to phenotypic sex should be considered as inter-sexes. The role of hormones, particularly from the medullary component of the foetal gonad in the differentiation of sex and genital abnormalities has been reviewed by Dr. Jost.

Dr. Parkes and Miss Parrot have given an interesting account of the method for orthotopic ovarian grafts to demonstrate in a convincing and elegant manner the viability of ova in ovaries previously frozen. The origin and development of oocytes in foetal and mature mammals is discussed by Sir Solly Zuckerman who points out that in the mammals, as in all the vertebrates, the oocytes develop extra-embryonally and migrate to the presumptive intra-embryonal gonadal region and that oogenesis, unlike spermatogenesis, ceases when reproductive life begins. 'Integumentary sex characters in vertebrates' is discussed by Dr. Harrison Mathews though he has not referred to the factors regulating the development of these characters. The role of gonadal and pituitary hormones, in conjunction with psychological factors, in the development and maintenance of these sex characters in vertebrates, needs further investigation.

Dr. C. R. Austin, the Editor and organizer of the symposium, is to be congratulated for the choice of the subject and for the excellent get-up of the book. There is no doubt that this number of the Memoirs of the Society for Endocrinology will be valuable to the research worker as well as to the University teacher interested in the study of the various facets of biology of sex in animals.

M. R. N. PRASAD.

Books Received

From: (Interscience Publishers, Inc., 250, Fifth Avenue, New York-1, N.Y.) :—

Extractive Metallurgy of Copper, Nickel and Cobalt. By Paul Queneau, 1961. Pp. xv + 647. $ 22.50.

Turbulance—Classic Papers on Statistical Theory. Edited by S. K. Friedlander and L. Topper, 1961. Pp. ix + 187. Price $ 6.00.

Interscience Tracts on Physics and Astronomy, No. 10—General Relativity and Gravitational Waves. By J. Weber, 1961. Pp. viii + 200. Price: Cloth $ 4.50. Paper $ 2.50.

Advances in Pest Control Research (Vol. IV). Edited by R. L. Metcalf, 1961. Pp. vi + 347. Price $ 12.50.

Treatise on Analytical Chemistry, Part II—Analytical Chemistry of the Elements, Vol. I. Edited by I. M. Kolthoff, and P. J. Elving, 1961. Pp. xxi + 471. Price $ 16.00.

From: (Cambridge University Press, 200, Euston Road, London, N.W. 1) :—

The Eleventh Symposium of the Society for General Microbiology—Microbial Reaction to Environment. Edited by G. G. Meynell and H. Gooder, 1961. Pp. 416. Price 42 *sh.*

Memoirs of the Society for Endocrinology, No. 11—*Cell Mechanisms in Hormone Production and Action.* Edited by P. C. Williams and C. R. Austin, 1961. Pp. x + 173. Price: Cloth 40 *sh.* Paper 25 *sh.*

The Evolution of Physics. By A Einstein and L. Infeld, 1961. Pp. xvi + 302. Price 13 *sh.* 6 *d.*

From: (Chapman and Hall, 37, Essex Stree', London, W.C. 2; India: Asia Publishing House, Nicol Road, Bombay-1) :—

Analysis of Deformation (Vol. 4), *Waves and* Vibrations. By K. Swainger, 1959. Pp. xxvi + 370. Price 75 *sh.*

Impulse-Voltage Testing. By W. G. Howley, 1959. Pp. xvi + 183. Price 32 *sh.*

From: (Academic Press, Inc., Pub., 111, Fifth Avenue, New York-3; India: Asia Publishing House, Nicol Road, Bombay-1).

Liquid Rockets and Propellants. Edited by L. E. Bollinger, M. Goldsmith and A. W. Lemmon, Jr., 1960. Pp. xv + 682. Price $ 6.50.

The Chemistry of Lignin. By F. E. Brauns and D. A. Brauns, 1960. Pp. x + 804. Price $ 18.00.

Mineral Metabolism an Advanced Treatise, Vol. I, Part A—*Principles, Processes and Systems.* Edited by C L. Comar and F. Bronner, 1960. Pp. xv + 386 + 30. Price $ 12.00.

Electromagnetic Wave Propagation. Edited by M. Desirant and J. L. Michiels, 1960. Pp. xiii + 730. Price $ 22.00.

Oxide Ceramics—Physical Chemistry and Technology. By Eugene Ryshkewitch, 1960. Pp. viii + 472. Price $ 16.00.

The Harvey Lectures, 1958-59 *and* 1959-60—Series, 54, 1960. Pp. xiv + 312. Price $ 7.50; Series, 55, 1961. Pp. xiv + 257. Price $ 8.00.

Nuclear Spectroscopy (Part A). Edited by F. A. Selove, 1960. Pp. xxi + 621. Price $ 16.00.

X-Ray Analysis of Organic Structures. By S. C. Nyburg, 1961. Pp. xii + 434. Price $ 13.00.

SCIENCE NOTES AND NEWS

The Natural Control of the Potato Tuber Moth

Sri. K. K. Nirula, Central Potato Research Station, P.O. Sahay Nagar, Patna (Bihar), writes :

Lizards *Hemidactylus brooki* Gray and *H. leschenulti* Dum. and Bibr. were found preying upon the adults and larvæ of the potato tuber moth *Gnorimoschema operculella* Zell., a very serious pest of stored potatoes in the plains of India. The number of adults and larvæ of *G. operculella* caught daily per lizard ranged up to 28·5.

In an underground potato store at Central Potato Research Station, Patna, very high populations of *G. operculella* were considerably reduced by these lizards during the summer months of 1959 and 1960. These lizards appear to be a valuable addition to the already known biological control agents of *G. operculella*.

Hosts of the Root Parasite *Aeginetia indica* Linn.

Sri. K. S. Venkataramani, Dowescroft Cottage, Quail Hill, Coonoor, writes :

In their recent note on the root parasite *Aeginetia indica* Linn. (*Curr. Sci.*, 1961, 30, 191) the authors, Chavan, *et al.*, remark that they have been able to trace only one host plant, *viz.*, *Dioscorea* sp. Last year, while, collecting plant specimens in the Mudumalai forests of the Nilgiris (elevation ca. 1,000 m. above the M.S.L.), I noticed several groups of *A. indica* scattered here and there under bamboo clumps (*Bambusa arundinacea* Willd.). As this root parasite is not a very common one, I availed myself of that opportunity to examine the nature of its parasitism and found that there was organic union between the bamboo roots and the roots of the parasite. Evidently they were parasitic on bamboo roots. The roots of the parasitized bamboo appeared normal, except that a small swelling was noticed at the region of the union. All the specimens I observed were under bamboo clumps, but in one instance the root parasite was seen associated with a root which was undoubtedly not that of a monocot. I, however, failed to trace the origin of the host root. *Dioscorea pentaphylla* Linn. is very commonly seen in the bamboo forests of Mudumalai, but I am not certain whether the unknown host root could have been that of this plant. As Chavan *et al.* mention, it seems unlikely that *A. indica* is a cosmopolitan root parasite, but one can never be dogmatic in this until more critical observations are made in several centres.

Low-Cost Reagent for the Extraction of Ascorbic Acid from Potatoes

Messrs. B. M. Gangwar and K. Swaminathan, Agricultural Chemistry Laboratory, Central Potato Research Station, Patna (Bihar), write :

Metaphosphoric acid is the ideal extractant for ascorbic acid from fruits and vegetables, but its cost prohibits its use for the analysis of large number of samples in a low-budget laboratory. Ponting and Wokes recommended 2% oxalic acid, which is considerably cheaper, as a substitute reagent. It was, however, found to be unsuitable for the extraction of ascorbic acid from potato tubers. This difficulty was overcome by using a mixture of metaphosphoric and oxalic acids.

The minimum proportion of metaphosphoric acid, which on incorporating to a 2% oxalic acid solution would be just sufficient to give clear extracts, was worked out.

It was found that a mixture of 0·25% metaphosphoric acid in 2% oxalic acid would be an efficient low-cost extractant for use with potatoes. Its choice was further justified when recovery studies showed that with this extractant, exactly similar proportion of the ascorbic acid added before extraction was recovered, as with the 10% metaphosphoric acid reagent.

Effect of Boiling Fishing Net Twines

Sri. G. K. Kuriyan and (Miss) P. J. Cecily, Central Fisheries Technological Research Station, Cochin-5, write :

Net materials of vegetable origin, particularly those of Cotton (*Gossipium* sp.), Sunnhemp (*Crotalaria juncea*) and Italian hemp (*Cannabis sativa*), due to their susceptibility to rotting by bacterial and fungal action, are usually treated by Indian fishermen with "tannins" to ensure their longevity. The sources of "tannins" are barks, twigs, leaves and seedcoats of different indigenous plants and trees. They are extracted by boiling the material in water or by exposure of admixture of the material and water to the sun for a few days. The netting fabric is treated in the hot, cold or pre-cooled extract. While some fishermen prefer the 'hot dip' process to obviously accelerate the amount of impregnation

of the preservative, others use a cold dyeing bath under the belief and personal conviction that heat might affect the strength property of the treated twine. To ascertain the possible effect of heat or boiling on the resultant strength, netting twines of cotton, sunnhemp and Italian hemp after determination of their original breaking strength, both in the dry and wet conditions, were immersed in boiling water for periods of 20, 40, 60, 80, 200 and 120 minutes and their strength determind after such exposure. Results showed that there was apparently no effect on the strength of the twines by boiling up to 120 minutes.

Tenth Anniversary of Turkmenia's Academy of Sciences

Since the establishment of Turkmenia's Academy of Sciences nearly ten years ago, it has become a large scientific centre. It has 22 scientific research institutes, and has provided the republic with scientific workers. Among them are 38 active and corresponding members, more than 150 doctors and candidates to sciences. The Institutes of the Academy are busy with problems which are of great significance for the development of Soviet Turkmenia's economy and culture. These include the solar energy, combined problems connected with the building work and the exploration of the Turkmenian Canal, finding useful deposits, and the study of history, language and folklore of the Turkmenian people.

Several institutes and laboratories are connected with industrial and agricultural enterprises of the republic. Scientists are giving practical assistance to the production workers and are summarising the experiences of the advanced working groups.—(*USSR Information Department, New Delhi.*)

International Conference on the Physics of Semiconductors

The Institute of Physics and the Physical Society on behalf of the International Union of Pure and Applied Physics, and the British National Committee for Physics is arranging an International Conference on 'The Physics of Semiconductors', which will be held at the University of Exeter from 16-20, July, 1962. The Conference is planned to follow the previous sequence of Conferences on the physics of semiconductors, which were held in Reading in 1950, Amsterdam in 1954, Garmisch in 1956, Rochester in 1958 and Prague in 1960.

Accommodation will be provided in Halls of Residence at the University. Further information regarding the Conference may be obtained from the Administration Assistant, The Institute of Physics, and The Physical Society, 47, Belgrave Square, London, S.W. 1.

Award of Research Degree

Andhra University has awarded the D.Sc. Degree in Physics to Shri K. V. V. Ramana for his thesis entitled "Studies on Ionospheric Drifts and Absorption"; and D.Sc. Degree in Chemistry to Messrs. P. V. R. Subrahmanyam and M. Balankeswara Rao for their theses entitled "Studies on the Nitrogen Changes in Sewage and Sludges" and "Studies in the Photochemical Sensitivity of Uranium (VI)—Carboxylic Acid Mixtures" respectively.

Colloquium on Documentation

A one day colloquium on 'Documentation' was held under the auspices of the Electronics Research and Development Establishment (LRDE), High Grounds, Bangalore-1, on the 28th June 1961. It was presided over by Prof. S. R. Ranganathan, and the delegates, over 60 in number representing about 30 research, scientific and technical organisations from various parts of India, were welcomed by Col. B. M. Chakravarti, the Director of Establishment.

The colloquium discussed the problems encountered in the Technical Information Centre of the LRDE on aspects of 'Storage', Retrieval, and 'Dissemination' of technical and scientific information.

The proceedings of the colloquium, to be brought out shortly, will be available, on request, from the Director.

Crystal Structure of He^4 and He^3

In the course of investigations of the thermal properties of solid He^4, Dugdale and Simon observed a first order transition whose equilibrium line cut the melting curve at 14·9° K. (*Proc. Roy. Soc.*, 1953, **218 A**, 291). As the heat of transition was found to be very small, about 0·8 cal./mole, the transition was assumed to correspond to a change of crystal structure from hexagonal to cubic close-packed.

Whether helium solidifies in the cubic closest packed structure as the other inert gases do has been of theoretical interest. Recently Mills and Schuch (*Phys. Rev. Letters*, 1961, **6**, 263) investigated by X-ray diffraction method, the structure of the new phase of He^4 occurring at temperatures and pressures above 14·9° K. and 1,100 atmosphere. They used the cryostat and camera arrangement, specially adapted to take oscillation photographs, for studying the crystal structure at low temperatures. They found that all the

reflections obtained could be indexed on the basis of a cubic lattice. The indices were always all even or all odd, indicating the face-centered cubic structure.

Prompted by this success, they further investigated the high pressure and temperature structure of He^3 (*Phys. Rev. Letters*, 1961, **6**, 596). They find that He^3 under high pressure also transforms to the face-centered cubic structure. Data at 18·74° K. and 1693 atmosphere gives the length of the edge of the cube as $a_0 = 4{\cdot}242 \pm 0{\cdot}016$ A. For He^3 the hcp.-fcc transition occurs at a higher pressure than it does for $He.^4$ It was observed that He^3 at 15·98° K. and 1341 atmosphere still had the hcp. structure.

Hyperon Stars

The extension of V. A. Ambartzumian's hypothesis of stellar evolution led G. S. Saakyan (*Priroda*, 1960, 11, 14) to develop a new hypothesis of stellar evolution based on the findings of certain recent discoveries of new elementary particles. According to this hypothesis dense stars of the type of 'white dwarfs' on further contraction become neutron stars. During this process their density changes from approximately 10^4 gm./cm.^{3} to about 10^8 gm./cm.^{3} With a further increase of density to 10^{15} gm./cm.^{3} these stars become hyperon stars representing a more stable state under such conditions. The mass of such hyperon stars in equilibrium is approximately the same as that of the Sun, while the size of their radius is of the order of a few kilometres. Only the central part of such stars contains hyperons. The outer zone is made of neutrons, while the outermost part is made of bare nuclei and electrons. The enormous pressure inside such stars is balanced by the force of gravity, but when such an equilibrium is disturbed hyperon stars are liable to explode with a terrific violence, not unlike the explosions leading to the formation of the 'nova' stars.—(*Nature*, 1961, 190, 961.)

Discovery of a White Dwarf Cluster

The Byurakan Astrophysical Observatory of the Armenian Academy of Sciences has recently announced the discovery of a great cluster of white dwarfs. It was detected on pictures taken with the 21-inch Schmidt telescope. The cluster has an elongated form with its largest linear diameter about 25 light years. It was discovered in the Lyre constellation about 800 light years away from the earth.

White dwarfs are super-dense stars of low luminosity and high temperature. So far, only about 300 isolated stars of this type have been known. This is the first instance when a whole cluster of white dwarfs has been discovered. As the white dwarf represents the last phase in the life of a star, the cluster must be very old—more than ten thousand million years. It is apparently older than other constellations of our galaxy. This determination has provided us with new data on the age of our galaxy.—(*USSR News.*)

Origin of Ocean Basins and Continents

Current ideas on the problem of the origin of ocean basins and continents are based on well-known hypotheses such as, the tidal resonance theory of Darwin, involving creation of the Pacific Ocean by escape of the Moon, the theory of migrating continents originated by Taylor and Wegener, and the various theories based on thermal convection. Most such theories were devised without taking into account a discovery of the last decade that the Mohorovicic discontinuity rises from its depth of about 33 km. under the continents to within about 5 km. from the floors of the oceans. This fact implies a profound difference in the structures of ocean basins and continents, which creates grave difficulties for most theories of the origin of these features, in particular for the theory of migration of continents.

J. J. Gilvarry recently suggested that the circular lunar maria are simply large meteoritic craters with sedimentary floors, excavated by explosive impact of meteorites on the lunar surface in the presence of a hydrosphere. He now proposes an exactly analogous mode of formation of ocean basins, as the results of explosive impact of large meteorite at a pristine time when the hydrosphere covered the earth to a roughly uniform depth. The disparity in the levels of the Mohorovicic discontinuity under continents and oceans enters the theory as an integral part.

The article is based on a reconstruction of the mensuration of the pristine oceans, and a correlation of their dimensions with those of the lunar maria, lunar craters (of Class V), and meteoritic and explosion craters in water. Thus, the presence of a terrestrial hydrosphere at the time of formation of the ocean basins is an essential element in determining the relative dimensions of the pristine craters.

According to Gilvarry's hypothesis the primordial ocean basins were simply the largest meteorite craters ever formed on the earth, entirely analogous to the circular lunar maria. The primordial continents were simply structures corresponding to the rims of these craters. —(*Nature*, 1961, 190, 1048.)

Odour and Molecular Vibration

The hypothesis has been put forward that odours of organic substances may be correlated with the low-frequency vibrations of their molecules. The similarity in the low-frequency Raman Spectra of Nitrobenzene and Methyl salicylate has prompted R. H. Wright to devise an indirect method of testing his hypothesis. The low frequency Raman lines in the two liquids are :

Nitrobenzene	183			408 cm.$^{-1}$
Methyl salicylate	185	263	356	428 cm.$^{-1}$

On the above hypothesis the odours of these two substances should be basically similar but with the odour of methyl salicylate altered from almond-like to wintergreen by the additional frequencies not possessed by nitrobenzene. It follows that a small amount of methyl salicylate added to nitrobenzene should be perceived by the nose more easily than a small amount of nitrobenzene added to methyl salicylate, provided due allowance is made for the different absolute thresholds of the two substances.

Wright's series of tests consisted in recording the reactions of twelve observers who were asked to smell solutions of different concentrations and identify the one that was different, and also to smell different concentrations of one liquid against a background of the other. The results showed that the wintergreen odour of methyl salicylate conceals the almond odour of nitrobenzene 10 times more effectively than the almond odour conceals the wintergreen odour. The effect is not large ; but it is distinct, and it is in the direction predicted by the vibrational theory of odour.—(*Nature*, 1961, 190, 1101).

Collision of High Energy Particles with Light Nuclei

Results of experiments carried out at the high altitude research station of the Uzbeck Academy of Sciences go to show that during interaction of high energy particles with light nuclei, the newly formed secondary particles get, on the average, less than 50% of the energy. There is very weak relation, if any, between the energy of the primary particles and that fraction of the energy which the neutral pi-mesons get during the collisions. These conclusions are at variance with the results obtained by other workers. The difficulty lies in evaluating the energy of the primary particles. In the Russian experiment carried out at an altitude of 3,200 metres, a calorimetric method of evaluation was used for measuring the energy of primary particles. The Cherenkov counters were used for this purpose for the first time.—(*USSR News.*)

Rotational Multiplets in the Oscillation Spectrum of the Earth

The free oscillations of the Earth are governed by gravitational and elastic forces. From the distribution of density $\rho(r)$ and the elastic constants $\lambda(r)$ and $\mu(r)$, as inferred primarily from seismic and from other geophysical data, it is possible to determine the oscillation frequencies (spectrum of the Earth) for the several proposed models of the Earth, *e.g.*, Gutenberg model, Bullen B model. This has been done in recent years by Pekeris, Alterman and Jarosch.

Occasion to test the results presented itself when the strain seismograms and gravimetric records of the Chilean earthquake of May 22, 1960, were made available. In the reports on this earthquake presented by Press *et al.*, and Slichter *et al.*, the former identified 52 lines in the strain seismograms, and the latter 49 lines in the gravimetric records. They reported that the gravest modes $n = 2$ (53·7 min.) and $n = 3$ (35·5 min.) appear as doublets in the strain-meter and gravimetric spectra. It was then suggested that the splitting is due to the earth's rotation.

While the Zeeman Effect furnishes ample experimental verification of the electromagnetic part of Larmor's theorem, an experimental demonstration of the mechanical counterpart has been wanting. Now Pekeris *et al.* (*Phys. Rev.*, 1961, 122, 1692) have extended their previous analysis of the free oscillations of a non-rotating self-gravitating elastic earth, by carrying out a first-order perturbation calculation of the effect of slow rotation on the frequency.

Their analysis yields the result that the degenerate frequency $\sigma_0(n)$ in the absence of rotation is resolved by slow rotation into $(2n + 1)$ lines, the separation intervals being proportional to the angular velocity of the rotation of the Earth. The Chilean earthquake results are shown to be in conformity with the theoretical deductions, thus proving the mechanical part of Larmor's analogy.

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